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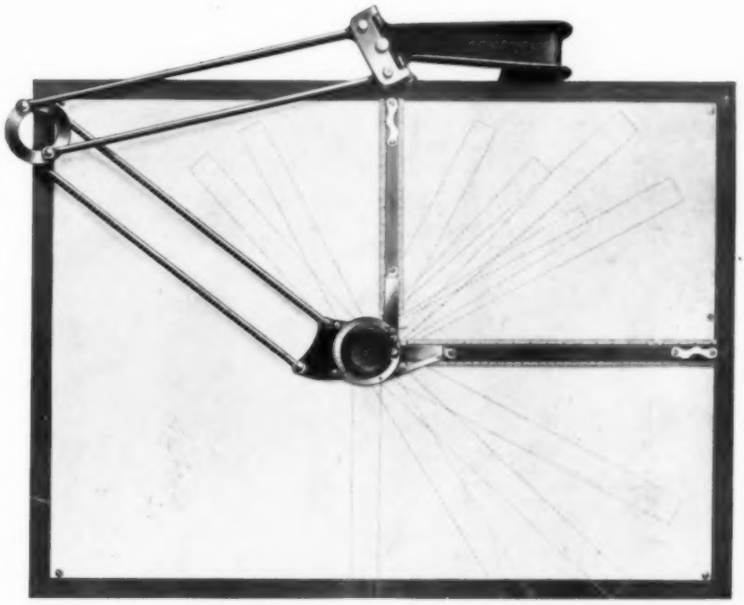

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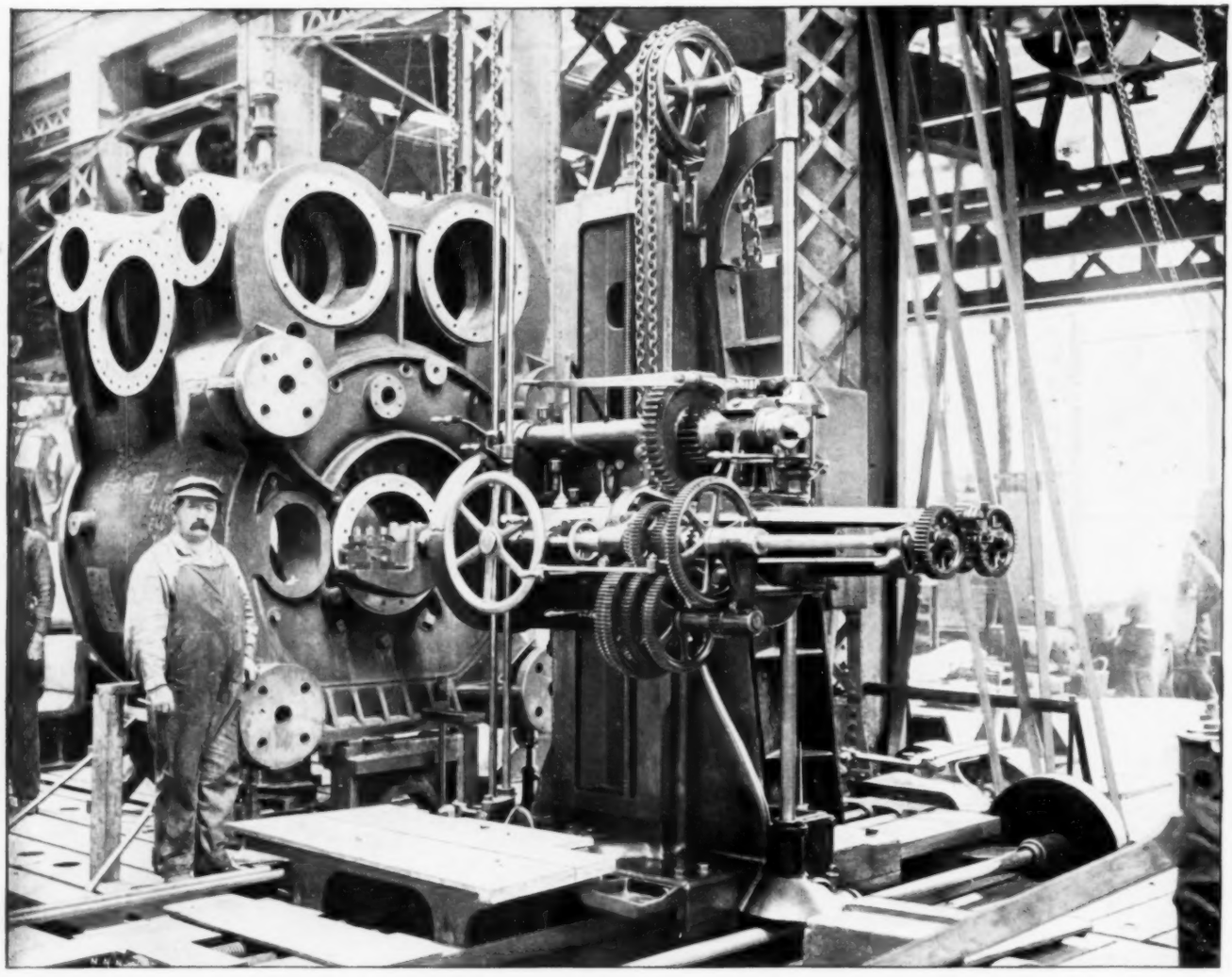

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(*See pages* 51, 52, 53, 54, 55, 56, 57 *and* 58)

Underground Pneumatic Postal Tubes

Diminutive Subways Which Carry Mail Long Distances. Another Mechanical Device Putting the Horse out of Business in Large Cities

BY R. S. BAYARD

In these days we are hearing a good deal about the digging and building of subways for the operation of electric trains underground to carry the busy people of our great commercial centers. There is another form of subway about which we do not hear very much, but of which there are many miles of underground tubes in our principal cities. These latter subways are very diminutive in comparison to the underground tubes which carry the electric trains for passenger traffic, as they are only 8 inches in diameter and the cars are only about 2 feet long. Despite the small size of these subways and their cars, the latter travel at the rate of 30 miles an hour and the distance between stops compares very favorably with the distance between express stations in the New York passenger subways, something over a mile. These small subways are for the purpose of carrying mail between the different branch post offices of cities and each little car is capable of carrying 600 letters at a time. Their installation is rapidly doing away with the once familiar mail wagon so it would appear that still another product of the machine shop is "taking away the job" of the horse.

For the mail-carrying subways the tunnels are long, bored, cast-iron pipes 8 inches in diameter, leading under the streets so that but few people are even aware of their existence. The motive power of the postal tubes is not electricity directly applied, but compressed air, which blows the carriers along the smooth interiors of the tubes with scarcely appreciable resistance.

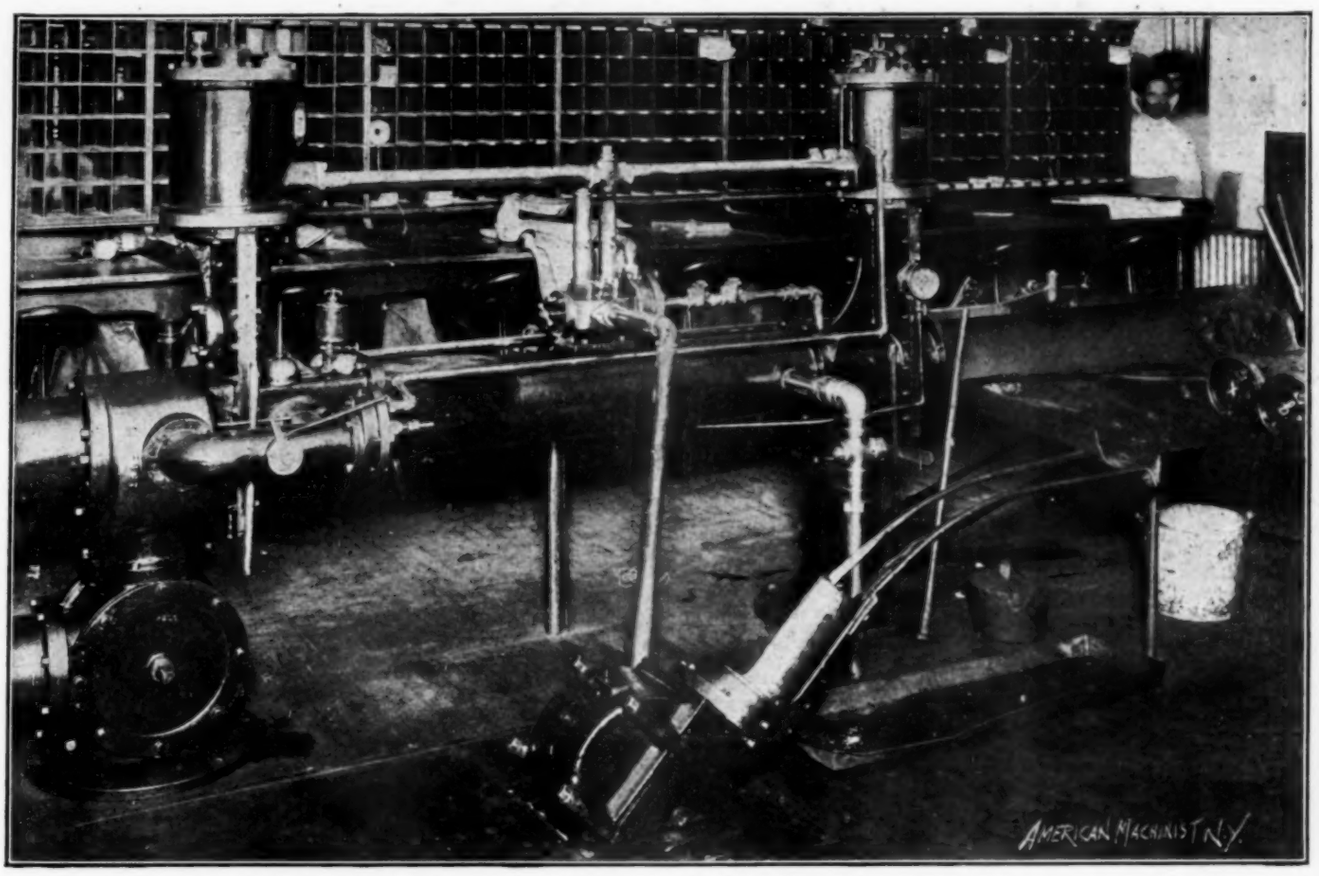


FIG. 1. DOUBLE-GATE RECEIVER WITH TRANSMITTER. PNEUMATIC POSTAL TUBE SYSTEM, NEW YORK CITY

Electricity forms the motive power for the compressing machines for pumping the air in most of the modern stations, although steam or any other power can, of course, be applied for this purpose. The air pressure in the tubes is very light compared to most compressed-air practice. In few cases does this pressure amount to more than 5 pounds, and usually it is between 2 and 3 pounds. The work of the air compressors consists in drawing air from one tube and pumping it into another one, the former acting to bring the carriers toward the station containing the compressors, and the other one carrying them away. Each carrier acts like a loose-fitting piston in the line and the rapidly traveling air pushes it along in the tube, the carriers following each other in series, separated by an air space of definite minimum length. The pressure required at the compressors is due mostly to the friction of the air traveling in the piping, there being but a slight additional pulsation as the carrier passes through the tube.

Where They Go in New York

In New York within the last few years a very extensive tube system has been installed, although this is not yet complete and many additions are to be made. At the present time, as will be seen from the accompanying outline map, the tubes start from the general post office in the downtown office-building district, from there leading to various parts of the city. One pair of tubes goes across the Brooklyn bridge, carrying mail to and from Brooklyn; another set forms a loop from

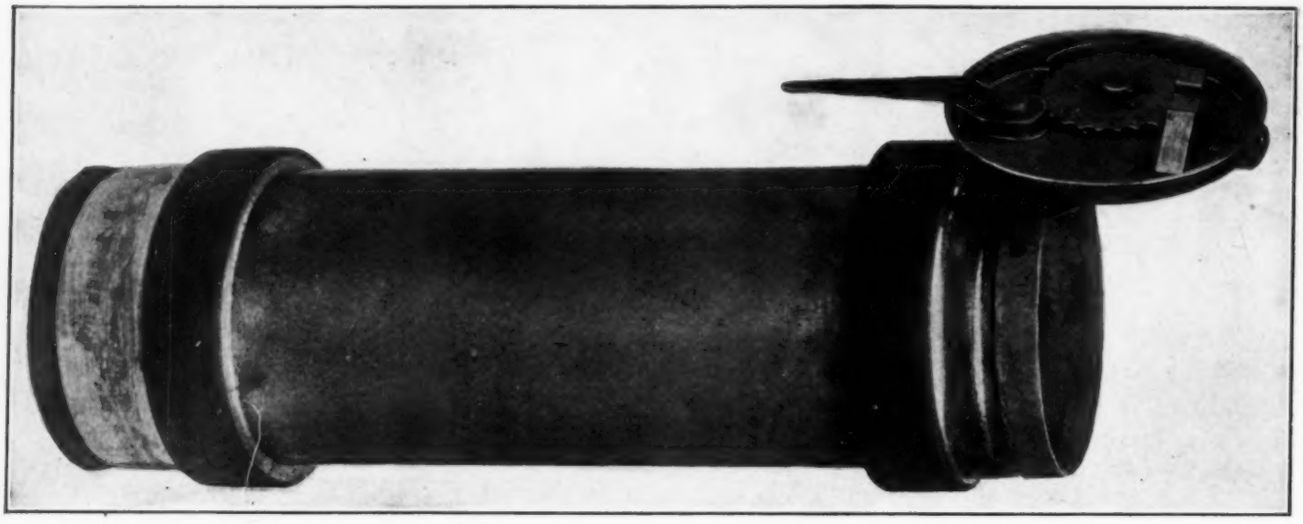


FIG. 2. CARRIER WITH LID OPEN

the general post office to the Wall street station, about half way between Broadway and the East river, and from there down to the new Custom House station on the Battery and finally back to the general post office again.

Another system leads from the general post office to the Hudson terminals of the Jersey City tunnels. Another leads up the west side of town, passing through 10 intermediate stations and finally crossing over to One Hundred and Twenty-fifth street and Lexington avenue in Harlem. This is a distance of over 10 miles and as the carriers travel at the rate of 30 miles an hour, it should take about 20 minutes of actual traveling, or adding a few minutes for transferring the carriers from one tube to another in intermediate stations, about 25 minutes' actual time from the general post office to One Hundred and Twenty-fifth street. This is many times faster than any mail wagon could ever do it, even if it were an automobile, and much quicker than either the passenger subway or elevated trains could carry the mail, especially as the latter would require wagon transfer from the trains to the various post offices.

There is another system leading up the east side of New York to Grand Central station at Forty-second street, there connecting by a cross-town line with the west-side system and a line now under construction will go from Grand Central station directly up Lexington avenue to join the existing line at One Hundred and Twenty-fifth street.

The Fool-proof Carriers

The accompanying illustrations show the general appearance and arrangement of the carriers and the transmitting and receiving apparatus in the post-office stations. It is said that more "gray matter" has been expended on the details of the carrier than on any other part of the mechanism. The carrier must be strong, not too heavy, practically water tight, easily opened and closed and so arranged that it cannot be inserted into the tubes until its lock is turned, and it should not be possible to turn the lock unless the lid is down tight and actual locking insured. Furthermore it is essential that the carrier shall remain tightly locked during transit.

All of these results are secured in the carrier illustrated. The long pointed handle operates the lid lock and in the unlocked position this handle projects outside the circle of the lid, making it impossible to drop the carrier into the transmitter. A spring piece on the inside surface of the lid furthermore prevents the turning of the locking handle to the locked position unless the lid is pressed down tightly to its seat, compressing this spring against the shoulder of the carrier, thus moving it out of the way of the locking cam. The lid swings on a link hinge so that when open it is entirely clear of the mouth of the carrier and a small clip on the inside lid surface conveniently holds the destination card so as to be readily seen. The locking handle is held closed by a snap spring and the lid is set down inside the rim of the carrier so that traveling with the lid end behind, the water in

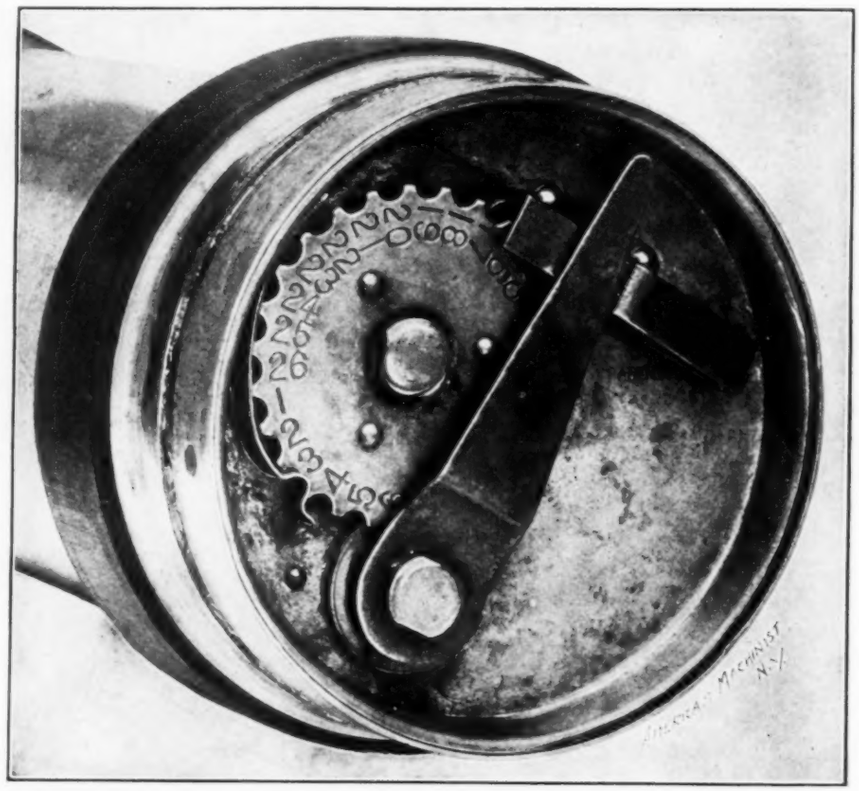


FIG. 3. DETAIL OF CARRIER LID

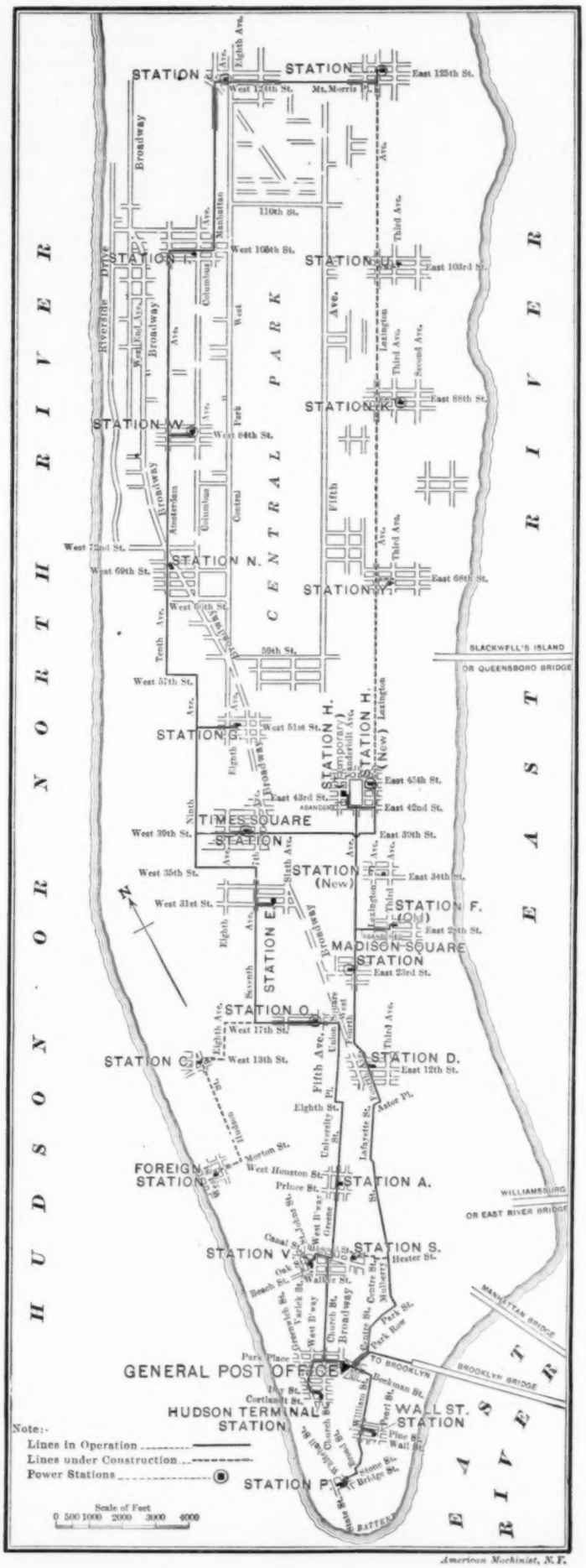


FIG. 4. OUTLINE MAP OF LOWER AND CENTRAL MANHATTAN ISLAND SHOWING ROUTES OF PNEUMATIC POSTAL TUBES

the tubes cannot be scooped into it. The front or closed end of the carrier is strongly reinforced by a steel stamping which also carries a felt buffer.

Galvanized sheet steel with soldered seams forms the material of the carriers and near each end is a ring of special rubber and canvas material forming bearing surfaces and permitting the carriers to round the 8-foot radius curves without binding either at the ends or the middle. A rotating numbered plate on the lid designates the destination of the carrier, each number corresponding to a certain post-office station and the plate being turned to suit. The lock handle also serves for lifting purposes. Carriers are said to last about eight or nine months and will travel 12,000 to 15,000 miles before requiring new bearing rings.

Transmitters

In New York there are two forms of transmitter used. One of these is shown in Figs. 1, 5 and 6 and takes the form of two swinging gates about 3 feet apart, in the end of a slanting pipe, the intermediate space being filled with air at the line pressure. The carrier containing the letters is laid in the trough *A*, Fig. 5, and by its weight it presses against a trigger on the side of the trough. The movement of this trigger opens a valve in the side of the chamber between the two swinging-gate sections, this valve serving to exhaust the air from this compartment. Both the swinging gates open downward and when the air has been exhausted from the intermediate chamber the weight of the carrier on the upper gate will cause it to swing down and allow the carrier to drop into the intermediate space. When it has passed in, a counterweight causes the upper gate to close and a small by-pass from the main or lower section of the pipe, below the lower gate, allows air to gradually leak from the line into the intermediate chamber, again building up its pressure.

When the pressure in the intermediate chamber has finally built up equal to that in the main pipe line, the weight of the carrier against the lower gate causes the latter to open and the carrier drops down into the tube, passing over a grated opening through which the air from the compressors is admitted and travels on in this current of air. There is a time lock on this device which prevents the too rapid feeding of carriers into the machine, which if they were closely bunched would bring too heavy a load and might lead to sticking of the carriers in the tubes. This time lock takes the form of a second trigger in the scoop to obstruct the passage of the carrier into the tube, together with a cylinder with a weighted piston. This cylinder is connected by a pipe to the chamber between the two gates so that normally it contains compressed air and its piston is held up to the top of the cylinder. With the piston in this position a

small opening in the side of the cylinder is uncovered, allowing air to flow through a small pipe to a cylinder and piston under the scoop of the transmitter, thereby unlocking the trigger. When this chamber is emptied by the entrance of a carrier, the weighted piston in the cylinder descends and the trigger in the scoop is locked until the weighted piston moves up again. The time required for the down and up movement of the weighted piston determines the minimum time interval between the despatch of carriers and this time can be adjusted by a suitable throttle valve. This lock mechanism is shown in the drawing, Fig. 5, just under the curved receiving trough below the letter *A*.

There is another form of transmitter, shown in Figs. 7 and 8, which is a little more elaborate than this one, and which is more positive in its action. In this latter type the intermediate space between the gates is normally subject to atmospheric pressure only. The carrier is inserted through the upper swinging gate and the closing movement of the gate itself opens a pilot valve which in turn moves a plunger slide valve, causing the admission of air to the intermediate chamber. When the pressure has become equalized with that in the pipe line the lower gate opens as before and by its closing motion a pilot valve causes an oil-controlled plunger, serving as a time lock, to move slowly down. At the end of its slow travel the time-lock plunger trips a small valve to throw air pressure to move back the main slide valve so as to again exhaust the air from the intermediate chamber, thus releasing the upper gate ready for another carrier. In this way, as long as the pressure in the intermediate chamber is maintained during the slow motion of the time-lock plunger, it is impossible to insert a second carrier to follow the first one too closely. All valves and pilot valves are ingeniously interconnected in such a way that the motions must be positive and complete, depending upon each other and following in regular order.

Receiving Apparatus

There are two forms of receiving apparatus. The necessity for two forms is due to the fact that some of the post-office stations are equipped with air compressors and some are not. The ones which are not supplied with compressed-air power constitute way stations in the line while the power stations are terminals. The difference is that at the terminals the pressure in the receiving tubes is reduced practically to atmosphere and the opening of a gate to allow of the discharge of a carrier does not cause any air under pressure to be blown into the room, while at a way station, the conditions are different, for the air at that point is at least 2 pounds above the atmosphere. This is because the air is passing by this station on its way back to the terminal station where again its pressure will become atmospheric. Although 2 pounds pressure is not excessive, it will be realized that when a gate is suddenly opened allowing 2 pounds pressure to blow out of an 8-inch pipe, a powerful draft is caused which would be very inconvenient, especially as the air sometimes contains oil and moisture.

Single Gate Receivers

Receiving devices for the terminal stations are quite simple, as there being no pressure above the atmosphere only a single gate is necessary to close the line and this gate operates more to check the speed of the rapidly traveling carrier than it does to keep the air from blowing into the room. As will be seen from the drawing, Fig. 5, and halftone, Fig. 9, the gate is of the vertical sliding type, lifted by a piston in an air cylinder above the pipe. The carrier, traveling at the rate of 30 miles an hour, comes in from the left around the gradual bend shown in Fig. 5 and after it passes the first upright pipe, which is a grated by-pass leading down to the compressor suction, the air in front of the carrier is almost completely trapped in the pipe by the carrier itself. This trapped air acts as a cushion which immediately slows up the carrier so that its velocity is not too great to enter the post-office room without damage. The cushioned air builds up pressure which is delivered through a pipe to a small plunger at the top of the main slide-valve chest. This plunger is normally balanced by air at practically atmospheric pressure on both sides, but the slight increase in pressure due to the advancing carrier and the trapped air moves this

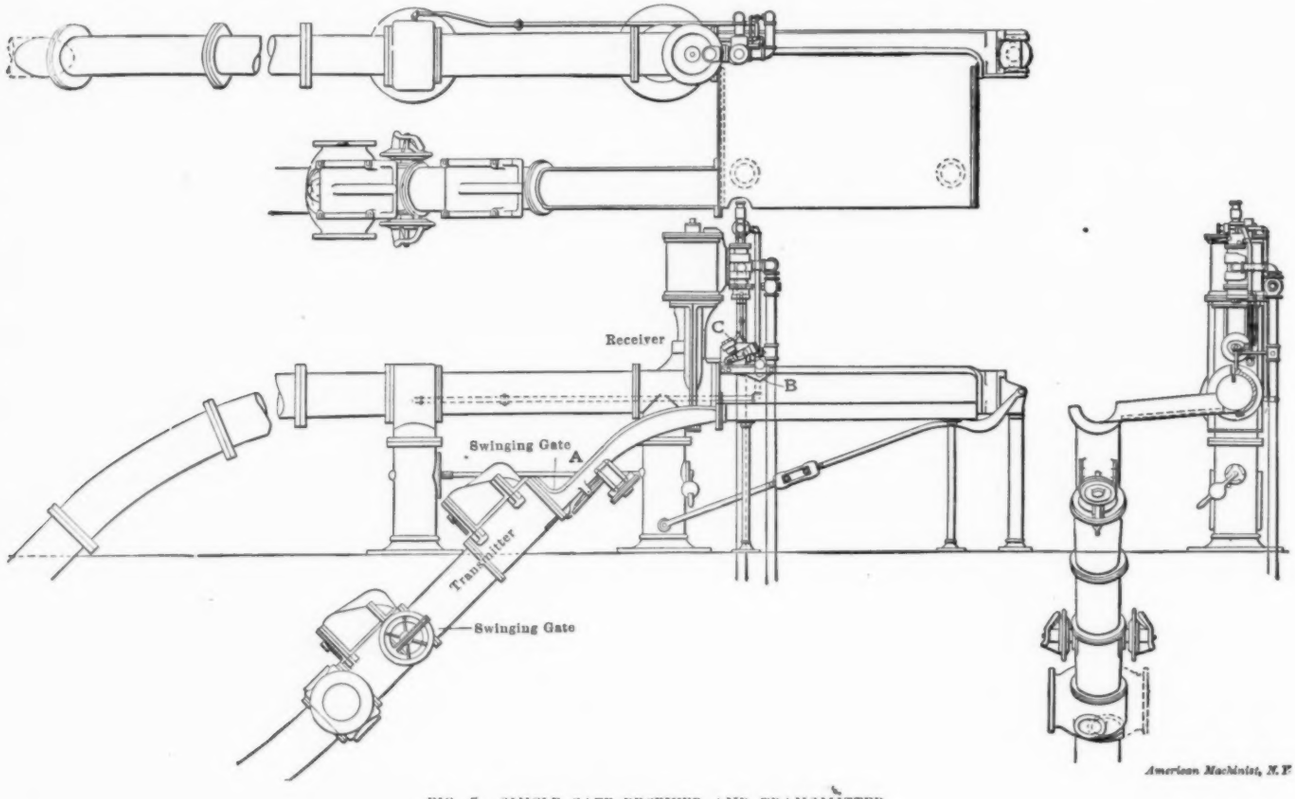


FIG. 5. SINGLE GATE RECEIVER AND TRANSMITTER

plunger over, releasing a trigger which in turn allows a spring to push down the main slide valve controlling the gate cylinder. When this slide valve has been pushed down, the piston in the cylinder lifts up and rapidly opens the sliding gate, allowing the carrier to be blown out into the room by a small amount of pressure which is created in the tube by throttling the outlet pipe. The carrier strikes against the cushion at the end of the trough table shown in the drawing and rolls toward the front, where it is picked up by the mail handlers.

As the carrier passes beyond the gate it lifts up the trigger *B*, Fig. 5, which causes a little latch, shown above the trough, to be drawn backward and upward and after the carrier has passed out, *B* drops down again, causing the latch to push against a small valve. This valve admits air below a plunger, again pushing up the main slide valve against its spring, reversing the action of the piston and again closing the gate over the end of the receiving tube. When the plunger of the slide valve has reached the top of its travel a port in the side of the cylinder is uncovered which controls air leading to a plunger in the small cylinder *C*. This disengages the little latch there shown, allowing the first balanced plunger which operates by the cushion air to return to its former position to hold up the main slide valve, thus leaving all the parts in normal condition for the reception of a second carrier. The object of all the interdependent actions is, as with the transmitter, simply to insure that each motion is complete in its turn before a second operation takes place, thus making the control entirely positive.

Double Gate Receivers

Figs. 1 and 6 show the general appearance of the intermediate or closed receiver. Here it will be seen that there are two gates and their object is, of course, to allow of the delivery of the carrier without allowing the air from the pipe line to blow directly into the room. Only one gate opens at a time, and the first one closes again before the second one opens, thus forming an air lock on the end of the pipe line.

As with the open receiver the operation is by the trapping of air by the advancing carrier. In the closed-receiver type, however, the first gate, which is shown to the left in the drawing, stands normally open and the air is trapped in front of the carrier between this gate and the final one at the right. The increase in pressure of the trapped air overbalances the plunger as before, which releases the spring of the main slide valve whose movement causes the closing of the left-hand gate. When this gate has reached the bottom of its travel, a port in the side of the cylinder controlled by the piston throws air pressure on the cylinder of the right-hand or final gate, causing it to lift up and open, while a small bypass delivering a little air to the lock space behind the carrier causes the latter to be expelled from the end of the tube with sufficient force to deliver it into the trough.

As before, the expelled carrier operates on the trigger shown above the trough which admits air behind the plunger of the main slide valve, reversing its action. This reversed position of the main slide valve pushes down the piston closing the right-hand gate, and when this has become closed, a port in the side of the cylinder controlled by the moving piston throws air on the cylinder of the left-hand or first gate, causing it to lift up and become open again so as to receive another carrier. When this piston has reached the top of the cylinder air is admitted to the small plunger over the trigger above the receiving trough, causing it to become disengaged from the valve there situated, again allowing the first balanced plunger to hold the spring of the main slide valve, leaving everything in readiness for the next carrier.

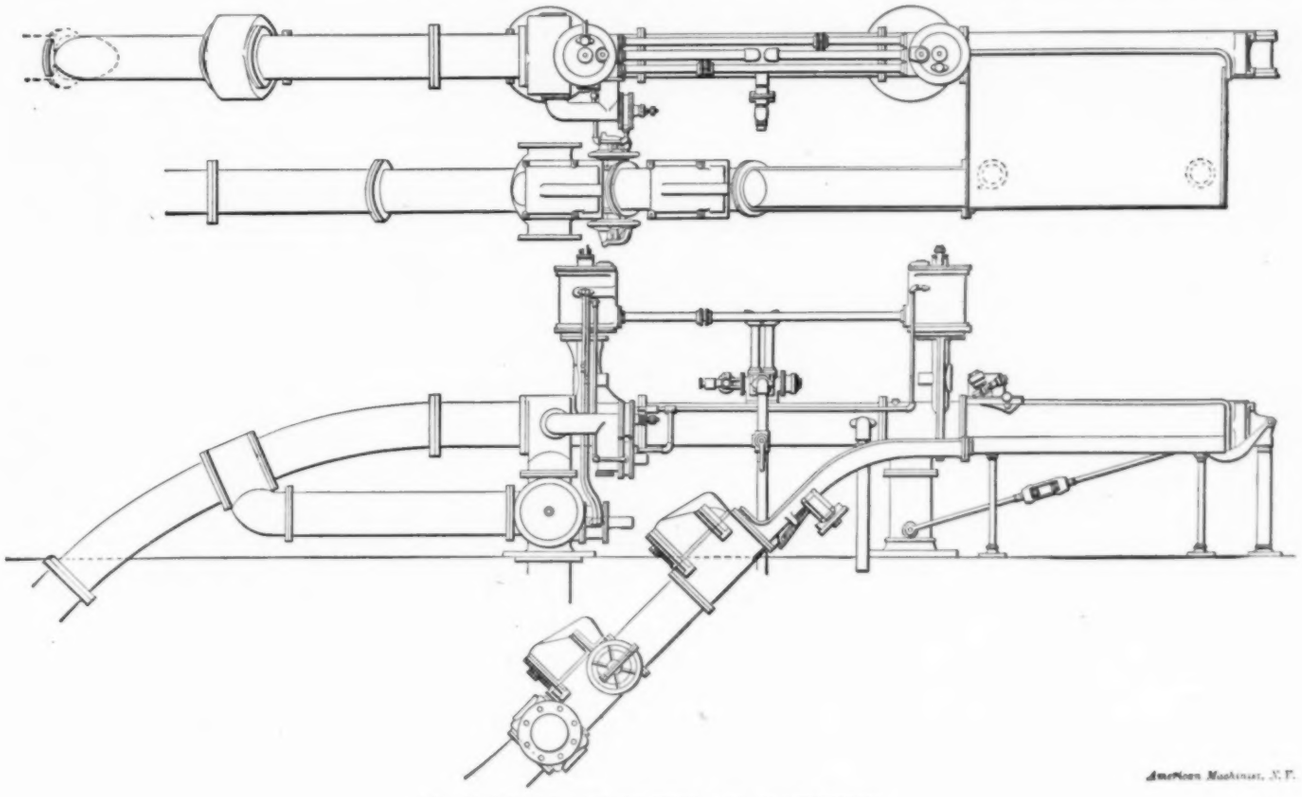


FIG. 6. DOUBLE GATE RECEIVER AND TRANSMITTER

It is a most interesting thing to watch the operation of these gates. A slight rumbling sound announces the approach of a carrier, the first gate closes, the second gate opens and the carrier is shot out into the receiving trough operating the trigger. The second gate closes and finally the first gate opens again, everything working with remarkable smoothness and rapidity. The air and the pressure in the line are delivered from the receiving tube to the vertical pipe just to the left of the first gate by means of a grid casting passing down into the transmitting tube below the second gate or air lock there situated,

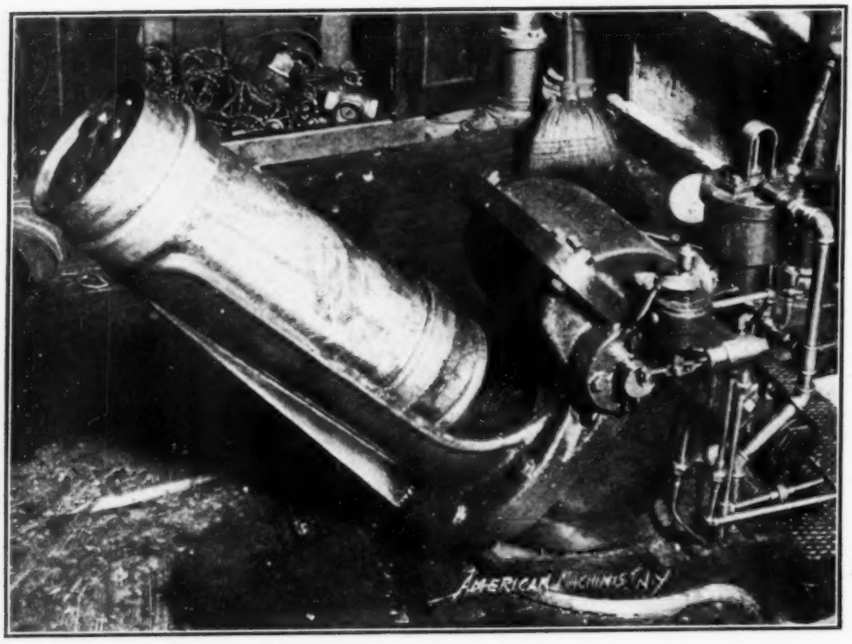


FIG. 7. A TIME LOCKED TRANSMITTER. CARRIER IN PLACE

as already described for the handling of carriers to be despatched.

REHANDLING VS. SWITCHING

As intimated, the carriers even for through traffic have to be rehandled at each station. There was at first devised a machine for switching the carriers automatically; that is, it was so arranged that certain carriers would pass by the station without tripping the mechanism, but by electric contacts certain other carriers caused the tripping mechanism to change the direction of the piping in the station to deliver carriers for that particular station automatically. One of these switching machines is shown in the halftone, Fig. 10, which is installed in the Wall street station in New York.

It was decided, however, that the devices were not necessary and their additional expense was not warranted. It was found to be much simpler to either end the tube division at each intermediate station, or else to employ the closed receivers in intermediate stations, as described, using the two gates.

Each carrier as it is despatched from any station is marked by the dial on the end to indicate for which post office that carrier is meant. As the carriers come into the station, the handler notes the dial and drops it into the transmitter leading to the station where it should go. Very little time is lost in this way, and considerable complicated mechanism is avoided. Furthermore, there is a card inside of each carrier which designates its destination. Missending is of rare occurrence.

Lubrication is secured by both oil and water; the oil comes from the compressors mostly and the water from the moisture in the compressed air. The bearing rings near the ends of the carriers do not tightly fit the tube so the car-

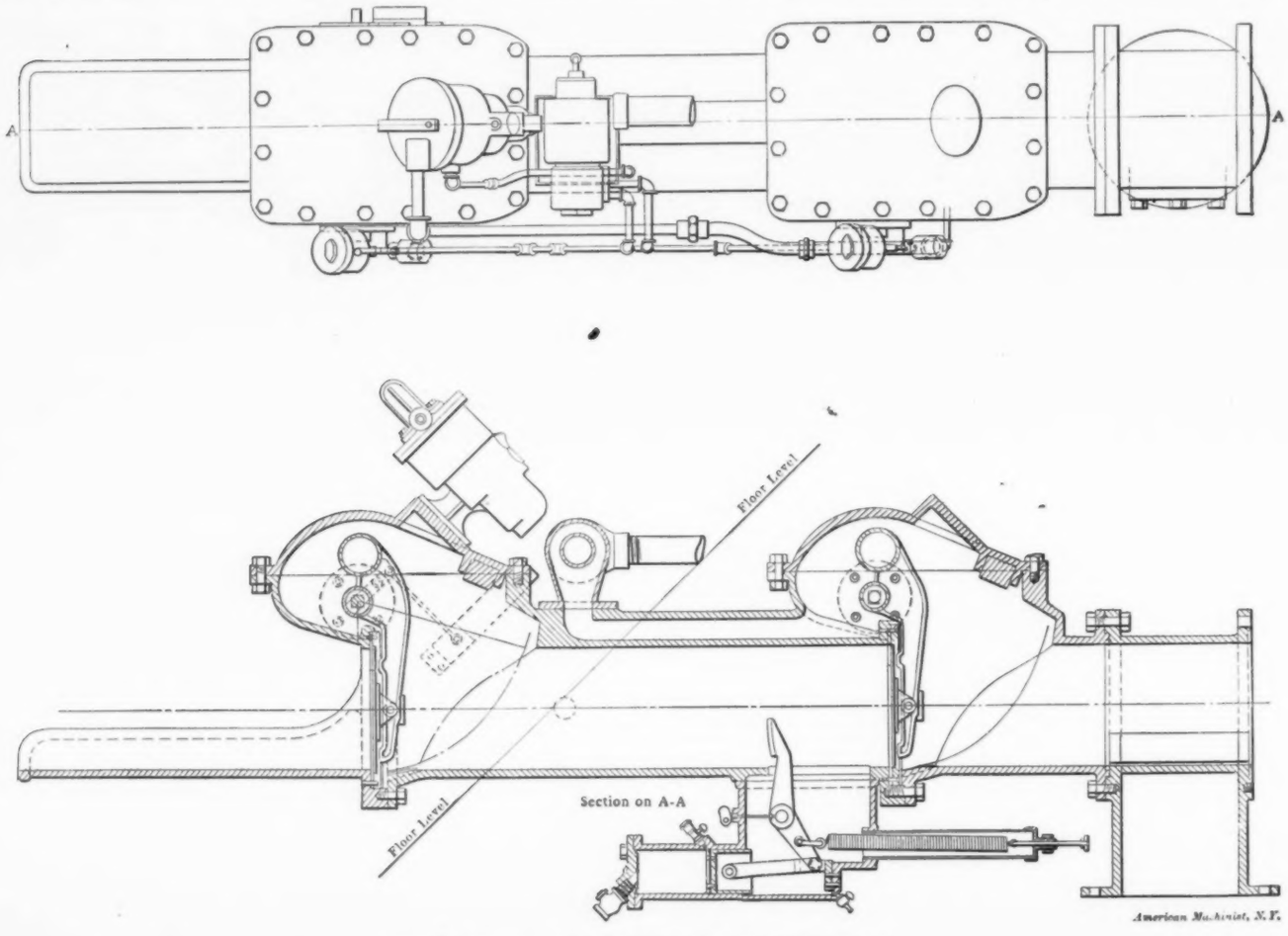


FIG. 8. POSITIVE TIME LOCKED FORM OF TRANSMITTER

rier is really traveled along in the current of rapidly moving air with scarcely any difference in pressure on its two sides. It is something like blowing leaves or bits of paper in the wind.

Hunting the "Blocks"

Once in awhile a carrier becomes stuck in the line due to some dirt or foreign substance having fallen into the tube. This is evidenced by two things, first of course, the carrier does not appear at the other end and second the air pressure at the compressor ends begins to build up. The compressors are so arranged that a considerable increase in pressure can be delivered by them and it usually suffices to thus build up the pressure, forcibly expelling the carrier past the obstruction. It becomes necessary sometimes, however, to dig up the tubing from the street and extract the carrier in this way although this does not happen oftener than once in two years. When it does happen it is highly desirable to know just about where the carrier is stuck and this is found at the present time by numerous convenient methods.

First at short intervals there are bleeder valves in the pipe located at street manholes and by trying these valves and noting the pressure, the location of the carrier can be roughly determined between any two of these bleeder valves. Also by counting the number of revolutions of the compressors it is possible to measure the quantity of air pumped into the tube to raise the pressure from any one figure to another. Calculations are made from this which with a little arithmetic quickly determines the volume of the tube between the compressor and the blocked carrier. Knowing the volume and the diameter of the tube a little further calculation soon determines the length or the distance from the compressor to the carrier.

When the position of the blocked carrier has been determined the next operation is to remove one of a series of special sections of the tubing which are made for easy removal, the flanges being bolted together and the alinement instead of being by a counterbore as in the rest of the tubes, being secured by means of dowel pins in the flanges. It is also arranged that each curved piece may be easily removed in this same way by taking out the bolts and dowel pins and from these openings long rods are run in, the carrier hooked and drawn out. With ordinary precautions the delays from blocked carriers are not very serious as a rule, and in the meantime the mail is either sent by some other tube route or transferred from some near station by wagon. When it is considered that a normal day's work from the general post office in New York is over 10,000 carriers and each carrier is capable of holding 600 letters these occasional delays are indeed a negligible percentage. It is further figured that between 40 and 50 thousand carriers are despatched from all New York post offices in 24 hours. This includes all rehandlings and as there are only 1400 carriers in service it shows that each one keeps on the go continuously and makes the complete circuit many times a day.

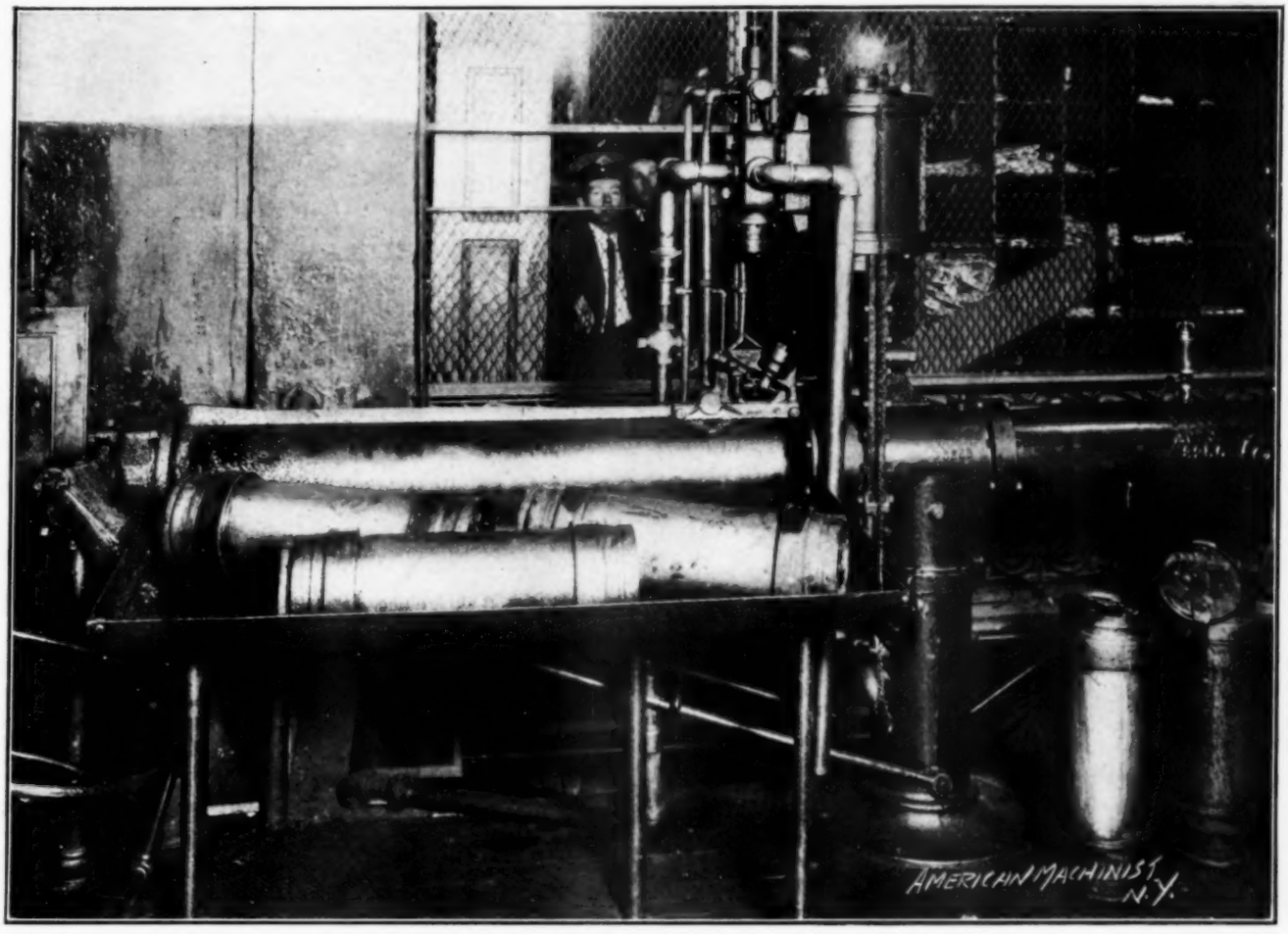


FIG. 9. SINGLE-GATE RECEIVER

Recording Locks for Registered Letters

Registered mail is sent in special locked sacks which fit inside of the carriers and the locks on these sacks, just as with ordinary registered mail sacks, are equipped with a numbering device which changes every time the lock is opened. In this way by taking triplicate copies of the number shown by the lock when sent from any one station to another it is quickly possible to determine whether or not this sack has been opened in the meantime.

JUST SO MANY FOR EACH STATION

All the different stations are connected by a special telephone system so that the foremen are in direct communication with each other. A certain schedule is also arranged so that each station is supposed to have on hand a certain number of carriers at each particular hour of the day. In this way it is assured that no station is without carriers enough to take care of the quantity of mail as it fluctuates from a minimum to a sudden maximum when, as in all cities, the afternoon mail begins to go out. In order to maintain this schedule of carriers it is especially seen to that the handlers in the station keep the carriers moving: that is, if they find that they are receiving carriers faster than they are sending them out, and their number is increasing beyond the allowable limit, the handler immediately despatches enough empty carriers to keep his own quota down to where it belongs. When these carriers are received at some other station, if their quota is also up to where it ought to be, they are simply reshipped into the tube leading to the next station and are finally kept by that station whose number is below what they should have, as of course the total number, counting all those in each station, must equal the total number of carriers in active service at any time.

"WINDJAMMERS"

Compressed air is furnished as a rule by reciprocating compressors of special design for the low pressures to be handled. Some of the machines lately installed in Philadelphia are of the direct-connected electric type with small engine-type motors mounted directly upon the compressor shaft without gearing or belting. The air valves on these machines, both inlet and outlet, are of the mechanically operated, rolling type, with double ports. In New York of late, some positive blowers of the rotary type have been installed and for the moderate pressures usually required are said to give excellent results.

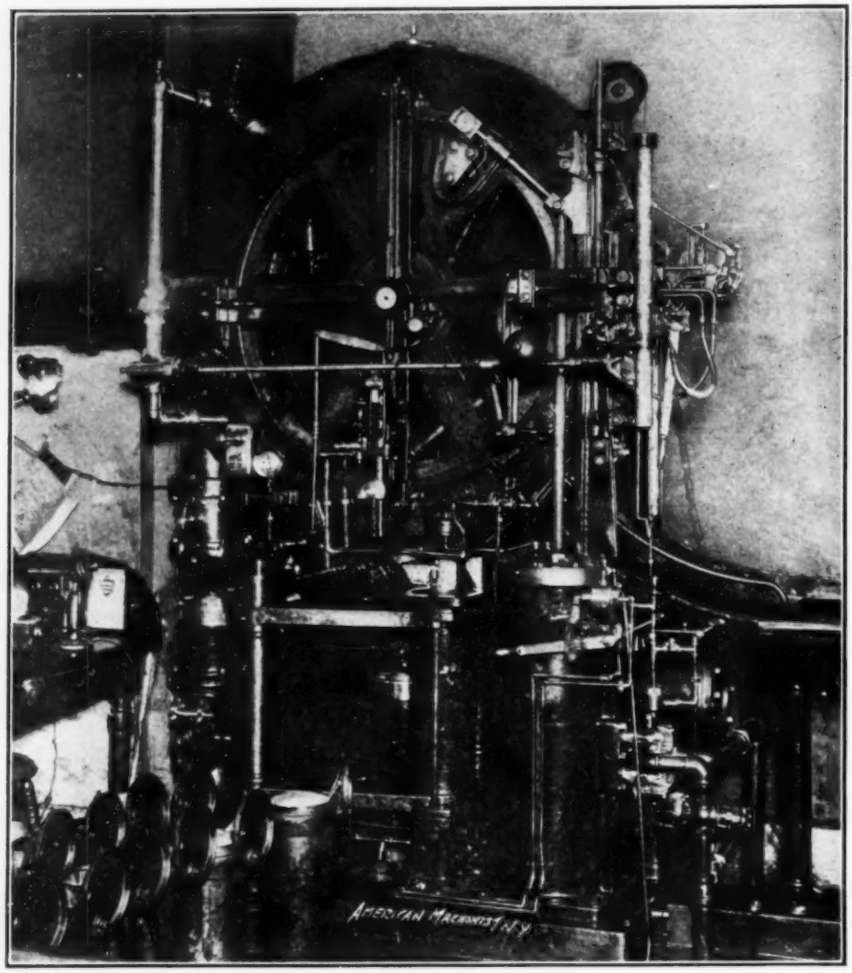


FIG. 10. AUTOMATIC SWITCHING MACHINE

In New York there are eighteen post-office stations served by the pneumatic postal tubes, these being shown on the accompanying map and there are two in Brooklyn. Of these, eight are equipped with compressing power and the others act as way stations, using the double gate receiving apparatus.

For the data and drawings thanks are extended to the New York Pneumatic Service Company, which has the contract for handling the mail through these tubes in New York City.

Measuring Appliance to Test the Alinement of the Axes in Bevel Gear Frames

BY W. POCKRANDT

It is general bevel-gear practice to test their accuracy of meshing before one builds them into a machine. This testing is not sufficient to insure that the bevel gears will run together freely in the machine for the holes for the supporting shafts can be made incorrectly.

It is also necessary, therefore, to test the housings or frames for the bevel gears, whether they possess the essentials for proper meshing of the bevel gears they are to hold.

An appliance which serves this purpose will be herewith described. By its use can be determined:

1. Whether the axes of both bearings for the bevel-gear shafts lie in a plane or the extent of the deviation.

2. Whether the axial plane lies parallel to the base plane of the bevel-gear frame and the distance between them.

3. The distance from the point of intersection of both axes from the front face of the bearing.

The appliance consists of two cylindrical bars, of which one carries on its end at right angles to its own axis a micrometer screw, whose measuring surface is located with the zero point accurately upon the axis of the other bar. The second bar has on one end a section of a cylinder of somewhat less than 180 degrees, whose inner corner shows in all positions the axis of the bar.

The bars are used with bushings the outside diameter of which corresponds with the diameter of the holes in the frames, and the inner with the outer diameter of the measuring bar, and are usable for different axis angles.

To test whether the axes of both holes intersect, or whether one goes over the other and the amount of the deviation, the bars are inserted in the holes in the manner shown in Fig. 1. If the positions of the axes are right, so must the measuring screw stand at zero, when it rests on the inner corner of the cylinder section on the end of the other bar. Otherwise, one can determine by adjusting the screw the extent of the error and therefrom correct the holes, or the arrangement in which the frames were bored.

In order to test the parallelism of the axial plane with the base plane of the frame, the frame is placed with the base plane resting upon a surface plate and with the help of measuring blocks and the micrometer screw the distance between the surface plate and the axes is measured at three points (see Fig. 2).

As to whether the axes are at right angles to each other, the following measurements can be taken: The distance of the

intersection of the axes for the front face of the bearings in the frame is measured by means of the micrometer screw with the use of measuring blocks in the manner shown in Fig. 3 (as a corollary thereto, can be determined the distance to the point of intersection of the axes for bevel gears located from the rear boss face of the frames).

By the use of a suitable test bar in place of one of the regular bars, can be determined further by this same appliance, whether or not both axes stand exactly at right angles to each other (see Fig. 4). Both measuring surfaces of the special bar must lie, in this case, exactly uniform to the bar in the second hole in the frame.

The excellence of the appliance, which is from Ludwig Loewe & Co., Berlin, Germany, lies in its many side applications, and especially in the accuracy of measuring through use of the micrometer screw, so that one can discover not only errors, but their extent.

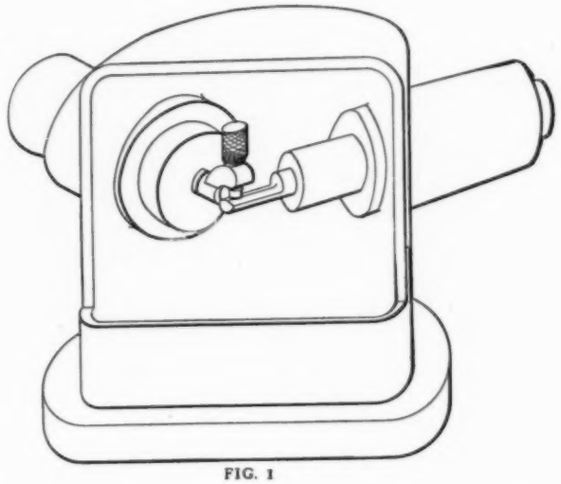


FIG. 1

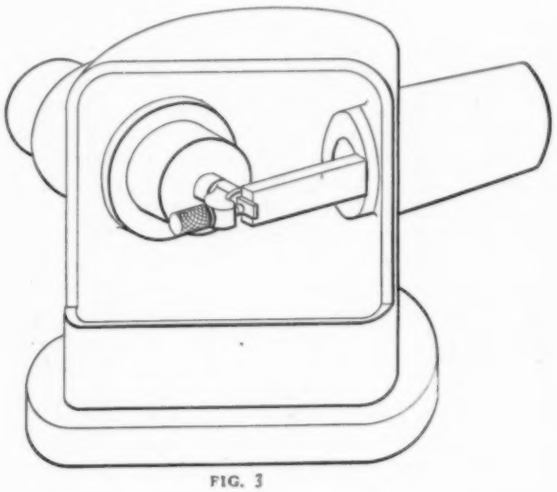
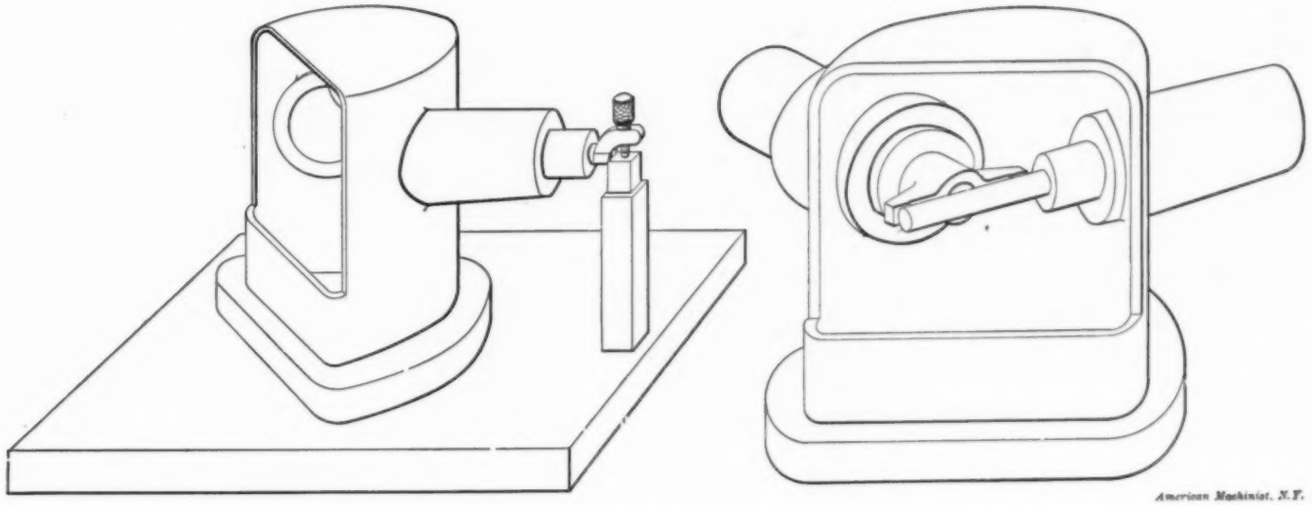


FIG. 3



American Machinist, N.Y.

APPLIANCE FOR DETERMINING ACCURACY OF BEVEL-GEAR BEARINGS

A Shrink Fit Problem

By G. J. Lemmens

I recollect that there appeared some years ago in the columns of the American Machinist a number of articles and a considerable amount of correspondence on the subject of shrinkage and driving fits. I have not the exact data which I believe were finally arrived at, before me. I should be very glad if any of your readers can offer suggestions with regard to the following problem:

I have to shrink a number of rings on to steel tubes about 4 inches in diameter. I propose that the rings and the tube shall be as far as possible of the same carbon content and general composition. I should be glad to know what would be a safe allowance to make in machining the inside of the rings and the outside of the tube in the following circumstances. The walls of the tubes are about ⅛ inch thick and have to be carefully ground internally before shrinking, with a final lapping after the rings are shrunk in place. A slight deformation would not be serious, since if necessary the tubes could be freshly ground to remove this. It is important, however, that after once grinding there should be no "aging" effect which will tend to disturb the true form of the inside. The whole may possibly have to stand a fairly high temperature ultimately. It appears to me therefore that the problem involves deciding the mean between too great a shrinkage, which may in time cause ripples on the inside of the tube, and, on the other hand, insufficient holding power which may lead to the loosening of rings under the effect of high temperatures.

Imports of iron and steel and of machinery into the United States for eight months ended Aug. 31 were valued at $13,407,611 in 1908, and $18,174,492 in 1909; an increase of $4,766,881, or 35.6 per cent.

Large Portable Shapers at Work

Morton Draw Cut Shapers in Use as Portable Tools for Boring, Milling, Shaping, Etc., at Allis-Chalmers Company's West Allis Plant

BY S. R. STONE

One of the most interesting features of modern machine-shop practice has been the development and use of the portable draw shaper, with boring and milling attachments, built by the Morton Manufacturing Company, such as the accompanying illustrations show.

In Figs. 1 and 2 are seen machines of this type built seven years ago for one of the largest machine shops of the country; and in contrast with these are presented the front and rear view, in Figs. 3 and 4, of a much larger machine recently constructed for the same works. This embodies such improvements as a constant study of operating conditions during five years, both by the designers and the users, has resulted in suggesting. Some idea of the evolution from the earlier type may be gained by comparing the illustrations; and the importance of these will be brought out in detail in the following description. In the later model the provisions for boring and milling are permanent features of the machine, so that the parts and tools merely need adjusting to position. These are a distinct advantage over the original type, where these were separate parts and had to be replaced for each operation requiring them.

The stroke of the new machine is 7 feet. Its bed is 18 feet long, with 12 feet of side feed; and the column is 15 feet high, permitting 10 feet of vertical feed. The internal arbor for boring is 8 inches diameter and it is fitted with a special spherical boring head.

The Shaper Mechanism

The shaper mechanism has a double-disk friction feed, with instantaneous change by tappets for vertical and horizontal movements. The power hoist and side traverse movement are operated by an independent direct-connected motor furnished with reversible controller, and so arranged as to give a good rate of speed in hoisting the apron or in moving the column sideways on the bed. Having a separate motor for this service was not a feature of the original machines, but it was early found to be very desirable and has since been incorporated in a number of those that had previously been put in service.

The reciprocating motion of the ram is obtained by open and cross belts and by two improved disk friction clutches that act very positively. The machine has a quick return and the cutting speeds vary from 15 to 30 feet per minute.

The bed of the machine is provided with open slots for the purpose of receiving bolts to secure the entire apparatus to the floor plate after it has been set in position by the shop crane. This is plainly shown in Fig. 1, which is a portable machine that is bolted to the floor; a shackle securely fastened to the top of the column enables it to be lifted and moved by the crane. Here it is shaping up the bearing of an engine frame in the West Allis shop of the Allis-Chalmers Company. Fig. 2 shows another view of the same job and the bearing is machined all over with one setting of the machine: i.e., the vertical and bevel sides of the inside, as well as the bottom, and the top, sides and bosses on the outside.

The column is very rigid to resist strains, with the base or saddle cast thereto, making them one piece. It is furnished with a truck built on anti-friction lines, and runs on a steel track for carrying a portion of the weight of the column, so that the strain will not come entirely on the bearings on the bed.

The speed-changing device enables three or more changes of cutting speed to be had at the will of the operator, which, when used in connection with the variable-speed motor drive of 3 to 1, or from 400 to 1200 revolutions per minute, gives a wide range of cutting speeds. The continuous-feeding mechanism is driven directly from the same source of power. The gears on the rear end of the ram, as shown to the right of Fig. 1, are so arranged that they may be easily disconnected when desired. A friction clutch is employed so that the countershaft may be stopped instantly at any part of the stroke without stopping the motor.

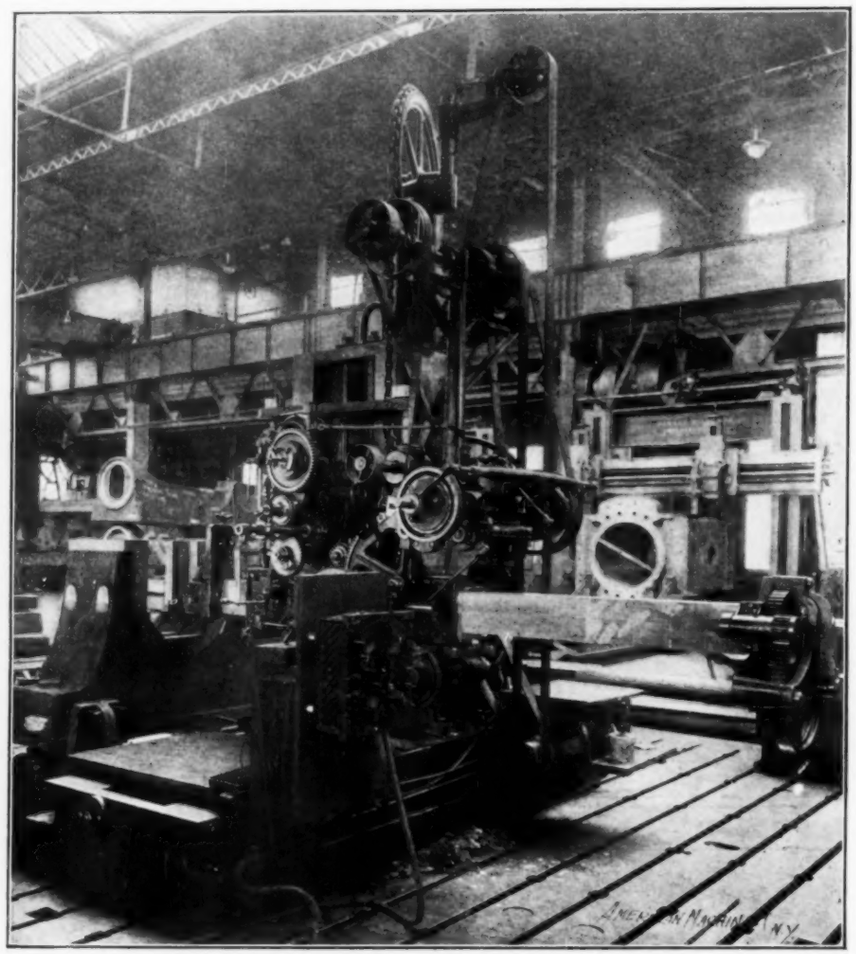


FIG. 1. EARLIER TYPE AT WORK ON ENGINE-BED BEARING

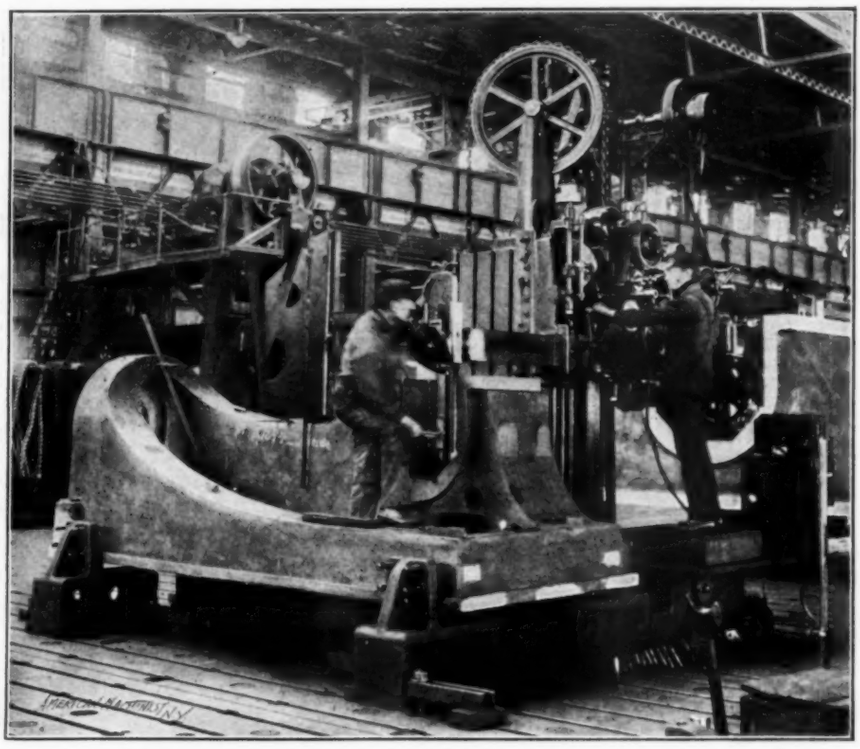


FIG. 2. ANOTHER VIEW OF EARLIER TYPE OF MORTON SHAPER

Shaper Grouped with Three Other Machines

During the period in which these machines have been in operation, they have been put to a great variety of service, and they have earned their original cost many times in the saving effected over what would have been possible with any other equipment available in the same shops. This would probably hold true of any shop where similar work is done.

In Figs. 3 and 4 are shown two views of the shaper as it is being used in conjunction with three other portable machines, all four machines being fastened to the iron floor plate and working on the casting at the same time. The shaper is machining the bearing inside and out, while two other machines, one at each end, are drilling holes and a special machine is turning and facing off the end, as shown to the right of Fig. 3. Fig. 6 shows the shaper milling a gas-engine bed, milling being one of the important features of this machine.

Boring and Milling Attachment

The boring and milling attachment consists of a hollow arbor passing through the square ram and journaled at the front end with bronze bushings which are made tapering to compensate for wear, the rear end being bushed with bronze, perfectly straight. The front end of this arbor is threaded, 1½ pitch square, for the purpose of receiving milling cutters and such other tools as may be inserted, while the rear end is applied with a suitable train of gearing that is incased and the journals lined with bronze bushings. Power is supplied to this train of gears by a spline shaft running parallel with the ram.

The feeding mechanism is provided with

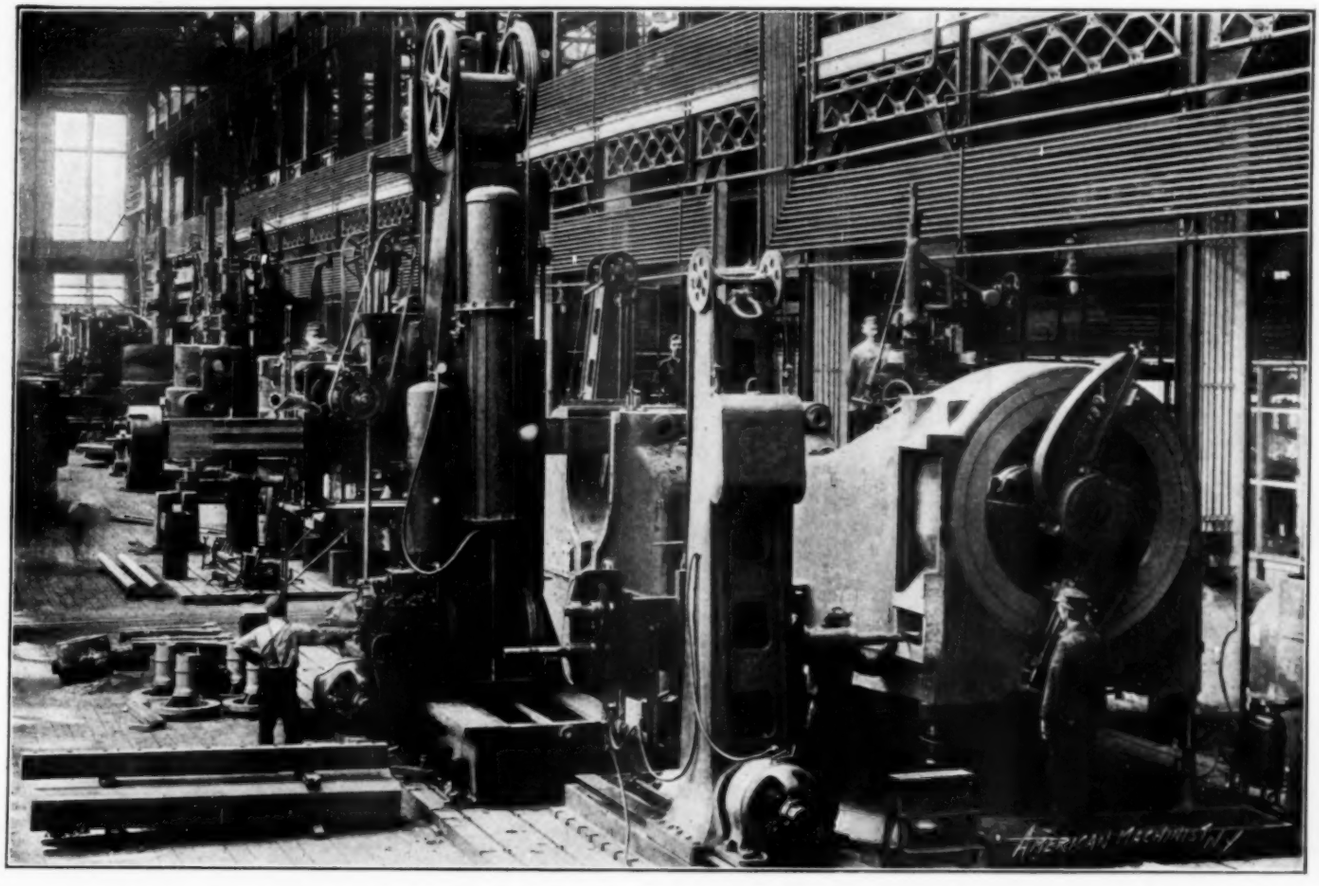


FIG. 3. MORTON SHAPER AS ONE OF FOUR TOOLS WORKING SIMULTANEOUSLY ON ONE CASTING

change-gear feed, giving ten changes. This is reversible so that the column may be fed in either direction on the bed, or the saddle fed in either direction on the vertical column, continuously, for face milling, etc. In respect to each of these features considerable improvement has been effected in the new machine.

The steel head, designed for boring, milling and cutting slots in spherical surfaces from 34 to 58 inches in diameter, as shown in Fig. 6, is provided with two swivel arms for carrying the cutters and with an automatic feed. The essential parts are clearly shown and they insure the absolute accuracy of the work and enable it to be done in a reasonable time.

Counterbalance

Special attention should be directed to the counterbalance of the pneumatic type, which is so arranged as to make as near a perfect adjustment of the saddle as possible. The air for this counterbalance is furnished to the cylinders shown on the back of the shaper in Figs. 3 and 5 by an automatically controlled air compressor driven by an independent motor, as shown in Fig. 8. Being automatically controlled, only as much air is used as occasion requires. As may be seen, the top of the compressor forms the base of the motor, making a very compact unit such as can be readily mounted on the column of the machine tool. The working parts of both motor and compressor are inclosed and thorough lubrication is automatically effected from an oil reservoir in the base.

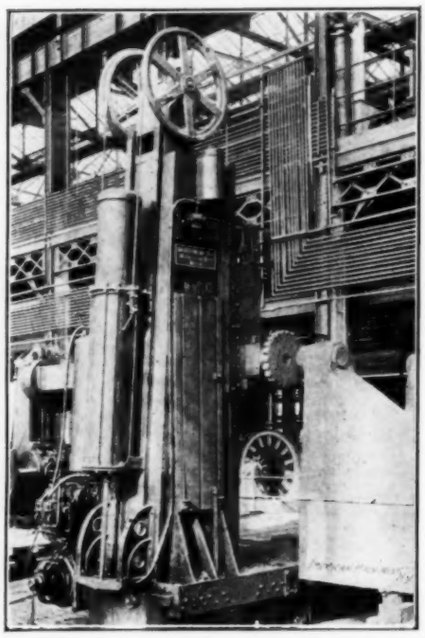


FIG. 5. MILLING GAS ENGINE BED

With this there is also furnished a pneumatic governor, as shown in Fig. 9, the service of which is to keep the air pressure in the storage reservoir within a fixed limit by breaking the circuit to the motor of the compressor when the desired pressure of air has been reached in the reservoir and to start the compressor again the instant it falls below a specified minimum.

Being automatic in its action, this entire compressor unit requires no attention while the tool is in operation, and it obviates any danger either of air failing or of its reaching such a pressure as to suddenly throw the counterbalance up, something which happened with the original type. The device is suited for operation under any conditions of machine-tool service where a supply of compressed air needs to be kept at a predetermined pressure and intermittently renewed.

Operation of Counterbalance

The governor possesses so much of interest, in itself, that a detail view of its working parts is shown in Fig. 9. When the pressure in the cap chamber *A* below the hard-rubber diaphragm *B* increases, the piston *G* is forced upward, compressing the spring *D*. The hammer *E* being forced by the piston rod past the dead center and actuated by a spring *F* in housing, *G* delivers a sharp blow to the yoke *H* carrying the contact arm *I*, through which the current is opened and closed. The copper contacts *J* are quick-

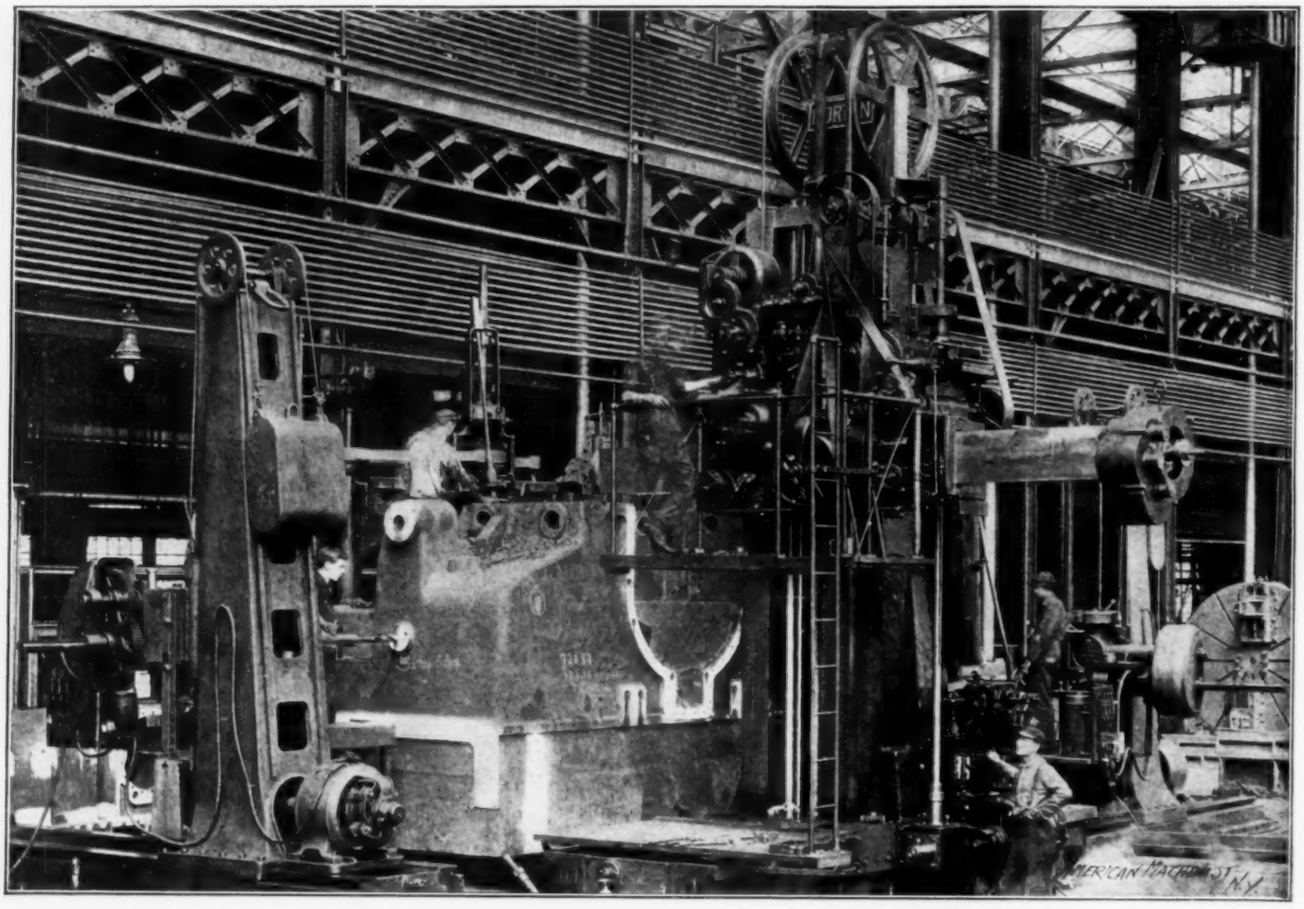


FIG. 4. ANOTHER VIEW OF FOUR TOOLS WORKING SIMULTANEOUSLY AT ALLIS-CHALMERS COMPANY

ly separated and the arc extinguished by the powerful magnetic field. These copper contacts are of liberal area and the contact arm *I* is made of spring phosphor bronze and well insulated. The pole pieces of the magnetic blowout are also protected by fireproof insulating shields.

As the air pressure is reduced, the compressed spring *D* starts to return to its former position. The piston rod again comes in contact with the trip hammer *E* and reverses its moment. The carrier *H* being carried over the center line of the pivot point by the hammer, returns with a snap action by reason of the springs *F* and *K* and closes the circuit. This quick action is important, as it reduces arcing to a minimum. It may be observed, also, that the contact arm is pivoted in such a manner as to give a wiping action to the copper contacts when the switch closes. The yoke is firmly held in either open or closed position by the compression spring *K*. The maximum pressure desired may be obtained by adjusting the screw *Q* which acts on the washer *R*.

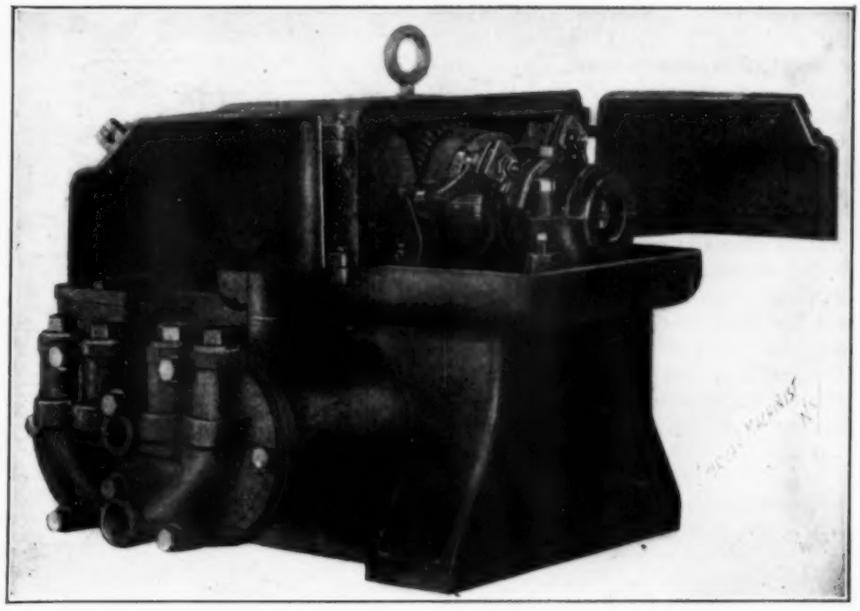


FIG. 7. MOTOR-DRIVEN AIR COMPRESSOR FOR COUNTERBALANCING

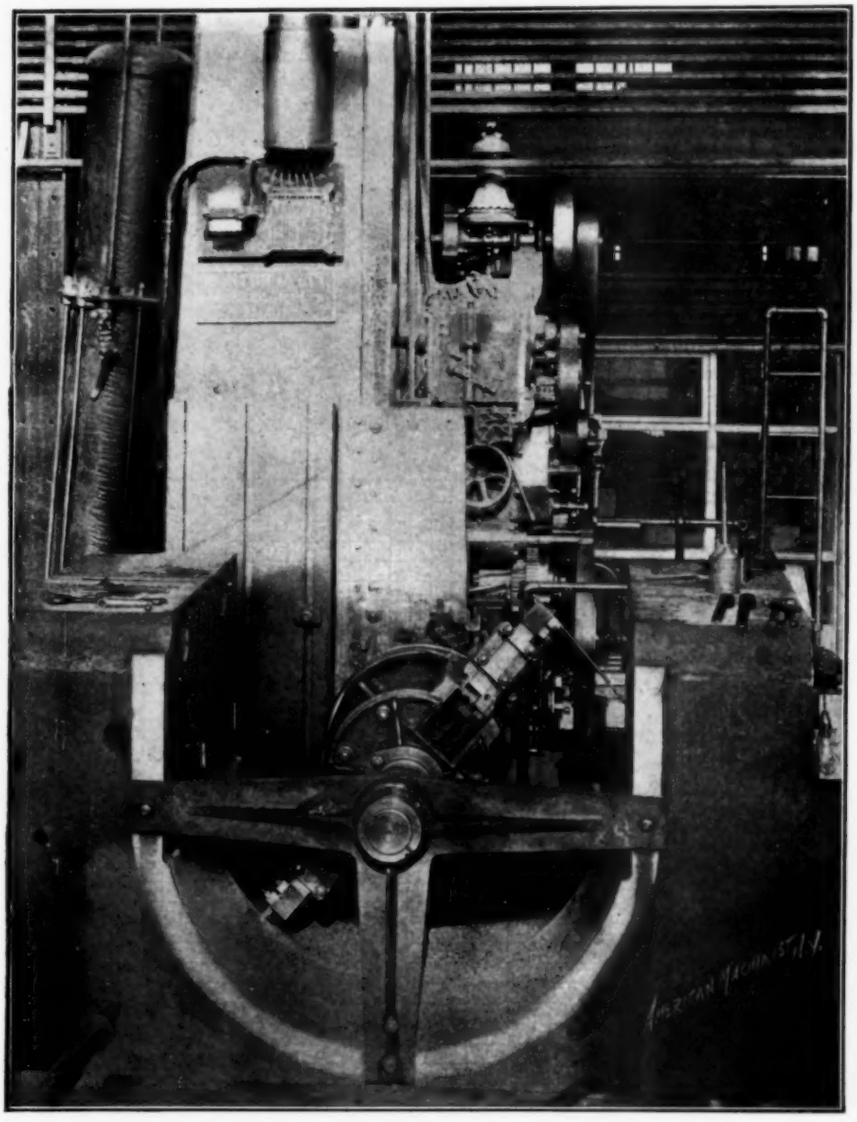


FIG. 6. BORING HEAD OF SHAPER AT WORK ON ENGINE-BED BEARING

The quick-break mechanism is mounted upon frame *L* which is fastened to the main body *M*. Blowout coil *N* and the fireproof insulating barriers *O* are mounted upon an insulating block *P* which is attached to the frame *L*. The compression springs *F* and *K* are protected by brass tubing and are interchangeable without affecting the calibration of the governor. The leads are brought out through insulating bushings in the governor frame and all working parts are easily accessible for inspection or repairs. The governor may be set, by means of screw *Q*, for any pressure between 15 pounds and 100 pounds and may be made to operate with a pressure variation of from 10 to 25 pounds, as is desired.

It will be noted that this governor is free from objectionable valves, ports, solenoid operating coils and other features which have proved sources of trouble in air-compressor governors. The current is made and broken, as shown above, by a snap action within the influence of a strong magnetic field, thus reducing the arcing at the contacts to a minimum. The switch is operated entirely by a diaphragm and the probability of leakage of air, or the failure of the governor to maintain its working margin, due to friction of a pressure piston, is eliminated. For machine-tool service the device presents particular advantages, inasmuch as it relieves the operative of the necessity of watching his supply of compressed air and enables him to concentrate attention on the work. Thus it is also being used on a Sellers planer at Allis-Chalmers' West Allis plant.

SUMMARY

The principal value of this tool lies in the ability of the operative to get at places in large work which could be machined with a standard tool only by means of a

special rig or would require the services of a skilled workman manipulating a pneumatically driven hand tool. They also save a great deal of costly hand labor which formerly had to be performed at the place of installation.

Among the services which are typical may be mentioned the following: Facing the inner edges of the round column frames of heavy vertical engines; boring a large bearing representing an odd segment of a circle; milling out pockets extending under the bed of a long, heavy machine; cutting slots in a cylindrical surface which would be out of range of any other tool, finishing off a single casting of too great length or of too eccentric lines to be worked upon by a standard

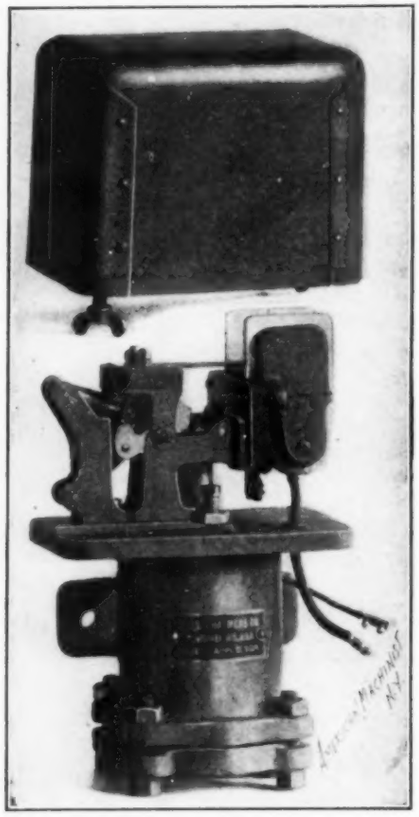


FIG. 8. PNEUMATIC GOVERNOR FOR AIR

planer; reaching projections on either the exterior or interior of large castings which are so situated as to be ordinarily inaccessible except to hand tools; and a great variety of unusual operations such as will probably occur to the mind of any practical machinist, foreman or superintendent who has read the foregoing.

The machines will not, of course, perform miracles; nor, on the other hand, can there be any economy in using them for operations that are suited to a standard tool already installed; but for large machinery building shops, where a great deal of work that is out of the ordinary usually exists, they are certainly worth considering.

The portable draw shapers shown in the accompanying illustrations, and specifically described above, were all built by the Morton Manufacturing Company, Muskegon Heights, Mich., for Allis-Chalmers Company, Milwaukee; and the air compressor, pneumatic governor and motors are of the latter's own manufacture.

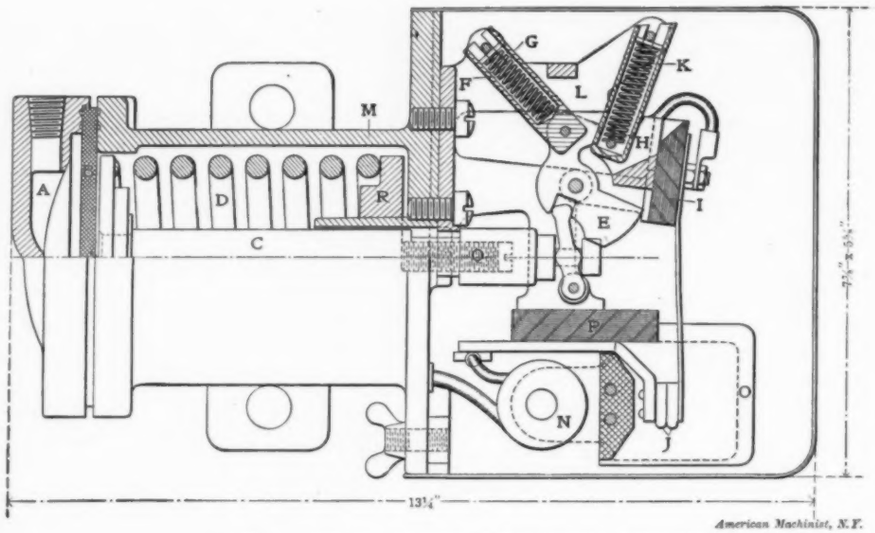


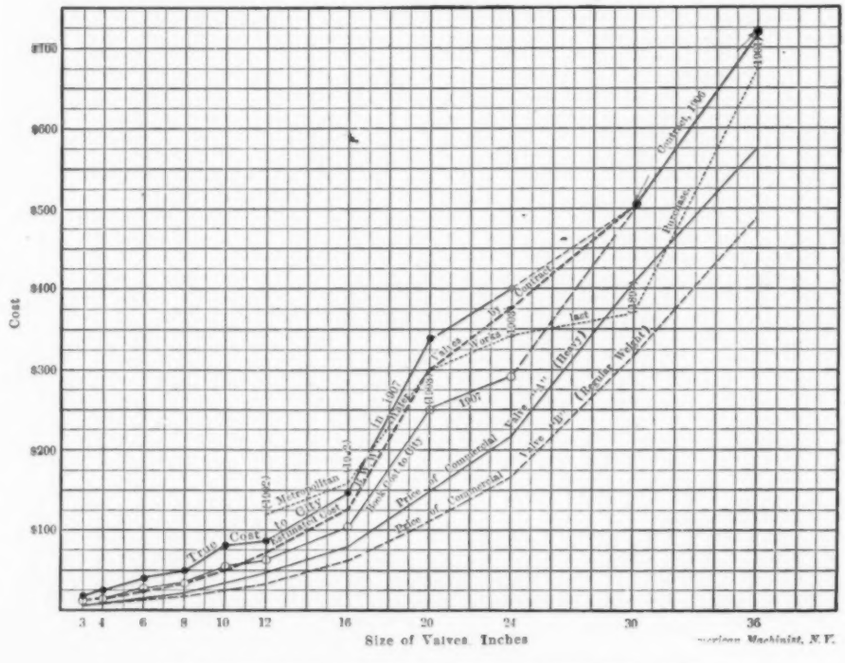
FIG. 9. DETAILS OF COUNTERBALANCING GOVERNOR

The Cost of Manufacturing Gate Valves in a Municipal Machine Shop

The Boston Water Department maintains a machine shop in which for many years past gate valves, hydrants, corporation cocks, stop-cocks and various miscellaneous supplies have been manufactured, gates and hydrants repaired, and miscellaneous work in drilling pipe branches and other machine-shop work carried on. In connection with their general investigation of the department made by Metcalf & Eddy, of Boston, a report was made regarding the work done on the above mentioned shop. From this report, which has just been published, the following facts have been drawn:

For two years prior to the report this shop employed a force of about 27 men, not including the blacksmiths or the engineers and firemen who ran the boiler and engine furnishing power.

In the year 1907 the total cost to the city of the articles manufactured in the shop exceeded $38,000, the cost of the repair work was nearly $3500, and of drilling pipe branches and other miscellaneous work over $2000—a total cost to the city of about $44,000 for the year.



COMPARISON OF VALVE COSTS—BOSTON WATERWORKS 1907

It is evident from a glance at the cost figures that the resulting cost of the gate valves, the principal articles of manufacture, was much greater than trade prices for the same sizes of valves.

Appraisal of the Plant

The machine shop was established in its present location about 16 years ago, and most of the machinery was installed at that time. In order to be able to judge of the value and condition of the equipment, as well as the amount of depreciation which should annually be charged as a part of the cost of the manufactures and repairs, the plant was examined and appraised by Charles T. Main, of Boston.

The valuations found by Mr. Main may be summarized as follows:

Item.	Approximate Cost.	Present Value.
Buildings, including only space occupied by machine shop for work on valves and hydrants.....	$18,000	$11,650
Power plant and shafting..	5,400	1,800
Machine tools, etc., first floor.....	11,400	5,400
Machine tools, etc., second floor.....	4,300	1,800
Blacksmith tools, etc.....	1,300	500
Pattern shop.....	900	500
Total.....	$41,300	$21,650

Methods of Determining Costs

The report of Metcalf & Eddy regarding methods of determining costs is a commentary upon the misleading character of an imperfect accounting system rendered all the more pertinent by the political conditions and influences. It was found that careful shop records had been kept of the time spent by the men upon each article manufactured, and also records showing the cost of the rough castings bought from private parties under contract. At the end of each year these records were summarized to show the cost of each article manufactured. The accounts, however, were incomplete, since they took no account of any cost to the city on the articles in question other than those of stock and of direct labor. The cost of holidays and other lost time for which men were paid, was not included, neither was the cost of superintendence, clerical service, fuel, engineers and firemen and other shop labor indirectly involved in manufacture, but not chargeable to any particular job of work. Further, all interest and depreciation charges upon the plant were omitted. The result of taking account of these items made the true cost to the city about 35 or 40 per cent. greater than that given by the department accounts.

To obtain the true cost of the direct labor which should really be chargeable to these manufacturers, it was necessary to add 13 per cent. on account of holiday and sick leave to the labor cost shown by the books of the department. The cost of superintendence, clerical service, fuel, oil, tools, engine-room labor and other general expenses, increased the labor cost of manufactures by 80 per cent. In other words, the actual cost of labor (including general expenses) in the manufacturing work was really 93 per cent. greater than that shown in the books of the department. Finally, it was necessary to add the annual amount of interest and depreciation upon the plant employed in this work, amounting to $2881 per year. These fixed charges were apportioned to the various items of work in the shop.

Manufacture of Valves

The principal item of work in the shop (about 37 per cent. in value) was the manufacture of gate valves, ranging from 3 to 24 inches in size. Larger valves than 24 inches, when required, were built under contract by private concerns, since the department shops were not fitted with tools of sufficient capacity to handle them.

These valves were built upon special designs prepared by the city engineer. The designs are excellent, and experience with the valves in operation has been very favorable. The designs differ considerably from those of any commercial valve upon the market, and have been used, with occasional modifications and improvements, from the establishment of the waterworks. Out of the 10,000 or so valves in service, only an insignificant proportion are of other patterns.

The Boston waterworks valves would be ordinarily classed as extra heavy patterns, although they do not differ materially in weight, especially in the smaller sizes, from the regular extra heavy pattern of one of the well-known valve companies, which are hereinafter referred to as "commercial valve *A*." They are, however, considerably heavier than stock patterns of most makers, and of the more generally used pattern of the maker referred to. The Boston valves also contain a considerably larger percentage of composition metal than any of the commercial valves, and this consisting in large part of copper, is, of course, much more expensive than any equal weight of cast iron. As a consequence, even if the Boston pattern were adopted by some maker and regularly carried upon the market, it would cost considerably more than any standard heavy commercial valve now obtainable.

It has been the custom from the beginning for the Metropolitan waterworks to have its valves manufactured under contract, from patterns furnished by the waterworks. A comparison of prices paid by the Metropolitan waterworks under this system, with prices of commercial valves, shows that the cost, as would be expected, is considerably greater than the cost of any commercial valve.

During the year 1907 there were manufactured in the department shops 260 gate valves of various sizes.

Chart of Prices

The accompanying chart shows:

First. The cost to the Boston Water Department, in the year 1907, of each size of valve manufactured, as obtained from the department's books.

Second. The true cost of such valves after adding labor cost of holidays and sick leave, shop superintendence and shop administration, and interest and depreciation charges upon shop and plant devoted to this work.

Third. The cost of the Metropolitan waterworks gates under their last purchase, with the dates of such purchases. (It is to be noted that most of these purchases were in 1902 and 1903, when prices were less that at the time of this report.)

Fourth. Prices at which "commercial valve *A*" could have been bought in 1907 (this is the heavy stock pattern of gate, the weight of which approximates that of the Boston valve).

Fifth. Prices at which "commercial valve *B*" could have been bought in 1907. (This valve is of the ordinary weight of stock valves.)

Sixth. Prices at which the engineers estimate the Boston valves could have been bought by contract in 1907.

It is evident from the chart as previously stated, that even under contract manufacture the Boston valves would cost considerably more than stock valves. It is estimated that this difference in the year 1907 would have amounted to 67 per cent. of the value of commercial valves, or in gross to the sum of $5000, an amount comparatively insignificant contrasted with the advantages of retaining the uniform pattern and the extra heavy valve now in use.

Comparing the estimated cost of the several sizes of gates, if made by contract, with the gross cost to the city in 1907, the latter is shown to exceed the former by the following per centages:

Size of Valve.	Per cent.
3-inch.....	36
4-inch.....	60
6-inch.....	53½
8-inch.....	32½
10-inch.....	47
12-inch.....	24½
16-inch.....	10
18-inch.....	12
24-inch.....	6

The engineers estimated the total annual loss from the operation of the shops in 1906 and 1907 at from $8000 to $10,000 as compared with the probable cost of similar goods by contract.

Prior to the investigation the discipline had been extremely lax, due in part to lack of power on the part of the superintendent and still more to the political influence through which many of the men obtained and held their positions. But a change of city administration and the presence of the investigators in the shop almost immediately led to a material increase in the amount of work done. In fact the reduction in direct labor cost all along the line was found to be at least 35 per cent.

Oil Burning Forges and Heaters

Forges with Openings on One or Both Sides or on Top, and Their Installation. End Heating and Tool Dressing Forges. Ladle and Torch Heaters

EDITORIAL CORRESPONDENCE

In the steady advance in the improvement of machinery and apparatus that has been going on for years, the old coal, charcoal, or coke-fired blacksmith's forge with its accompanying dirt, smoke, gases and foul odors, and its handworked bellows, has given way to furnace forges that are practically as clean as the machines in the machine shop.

In making the much-needed improvements the fuel has been changed, and the coal with its dirt, smoke, etc., has been abolished by substituting gases of different kinds and oil in its place. As well as making the forges clean and pleasant to operate, the change has made a considerable reduction in the fuel bills. Fuel oil, which is the product used in the forges and heaters herein described, has proved itself to be one of the cheapest fuels, and has thus supplanted the coal-fired forge in many places.

These styles of furnaces have another advantage over the coal-fired forge, which is that they can be heated to any desired temperature, and that temperature maintained permanently by setting the valves which admit the oil and air to the burner. This is a very desirable feature of the oil- or gas-fired forges and one that could not be accomplished with the old forge.

Single and Double Opening Forge Furnaces

In Fig. 1 is shown two styles of the most common type of forge furnace, one of which has the opening on one side only, and is used for heating small pieces, or the ends of larger ones. The other has an opening on both sides, opposite each other, so that long bars can be shoved through and heated in the middle. This opening is left 5 inches high on this size of furnace and it can then be bricked up to make the opening small enough to suit the work. Burners are located on each end of these forges, so that the chamber will have a uniform heat its entire length.

A double steel plate is located above the opening to protect the operator from the heat of the furnace, and in conjunction with this an air blast is sent through the pipe that comes up through the floor and runs along the entire front of the furnace immediately below the opening. This air blast drives the heat which might come through the opening up the back of the steel plate so that the operator can work in comfort.

The details of the construction of the double-opening forge is shown in Fig. 2. The single-opening forge is practically of the same construction with the exception that the one opening is closed up with firebrick and forms the back of the furnace, while the sheet-metal heat protector and air blast are removed from that side of the forge.

Top-slot and End-heating Forges

For work which cannot be readily handled in the above forges an adjustable top-slot furnace like the one shown in Fig. 3 is manufactured. An adjustable clamp for holding the brick which covers the opening is furnished with this forge, and the opening can be made any size suitable for the work. As will be seen, these forge furnaces are simple in construction, easy of control, taking practically none of the operator's time for that part of the work, and are made so that nearly any kind, size or shape of piece can be handled.

In Fig. 4 is shown an end-heating furnace fitted with a door which can be raised or lowered to open or close the furnace.

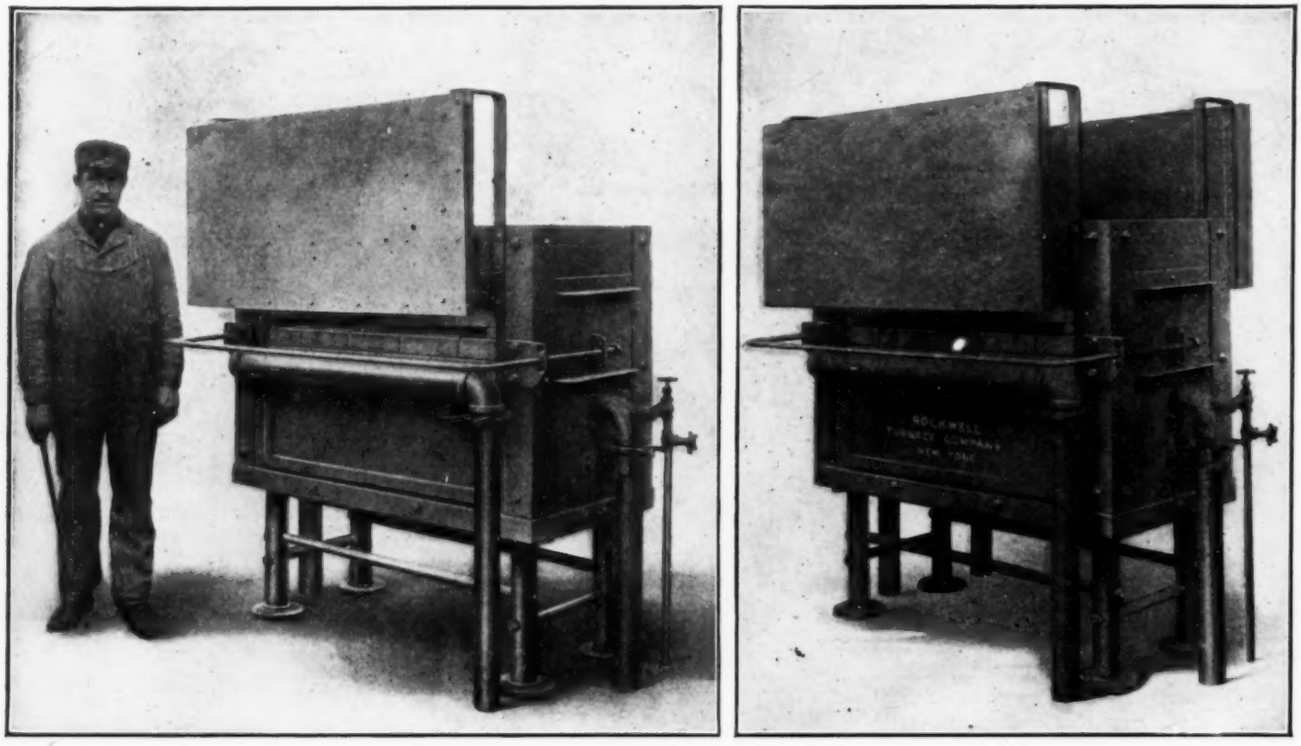


FIG. 1. SINGLE AND DOUBLE OPENING FORGE FURNACE FOR END AND CENTER HEATING

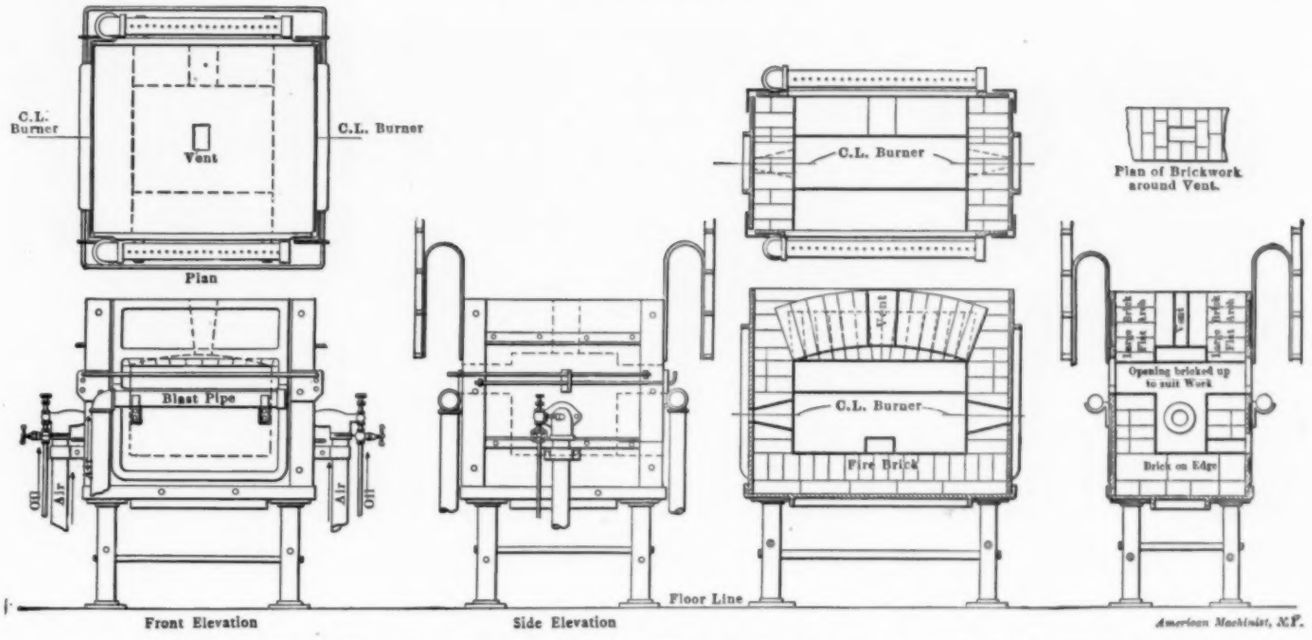


FIG. 2. DOUBLE-OPENING FORGE FURNACE SHOWING PIPING FOR OIL AND AIR AND INTERIOR ARRANGEMENT

INSTALLATION OF FORGES

In Fig. 5 is shown the method of installing these furnaces with their apparatus for oil and air. As will be seen, the two pipes are laid under the floor, one to deliver the oil and the other the air blast, and the furnaces connected up to these. While this is the best method, if conditions are such as to make it desirable these pipes could be carried to the ceiling instead of under the floor. Gases such as natural gas, coal gas, water gas, producer gas, etc., can be used in these

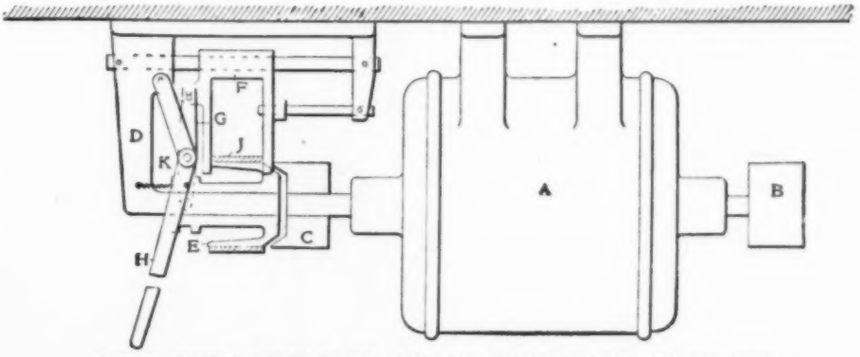


FIG. 5. INSTALLATION OF OIL AND AIR FURNACE USING OIL FOR FUEL

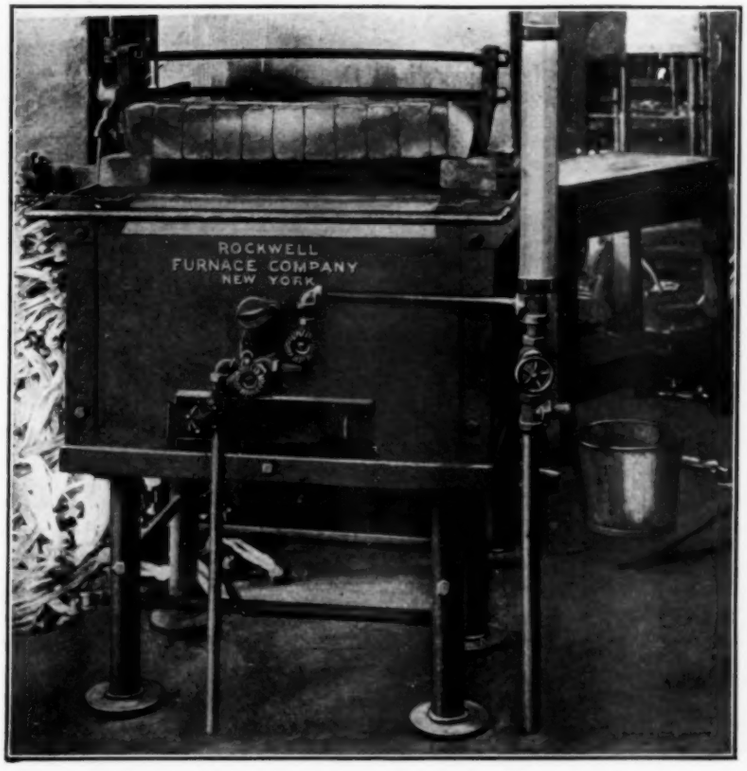


FIG. 3. ADJUSTABLE-TOP SLOT OIL FORGE FURNACE

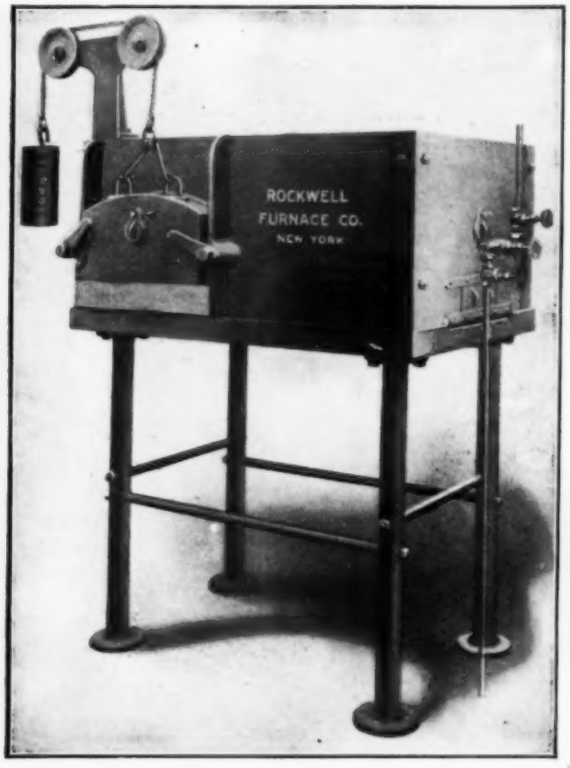


FIG. 4. END-HEATING FORGE FURNACE

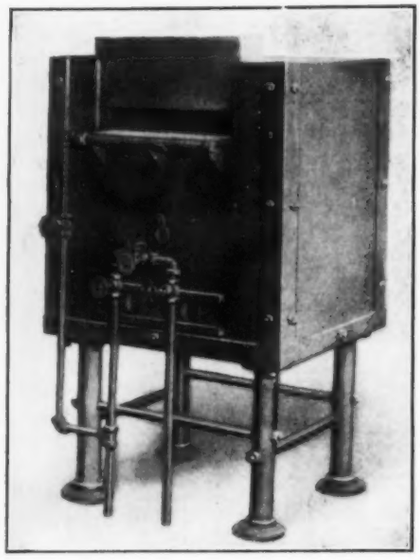


FIG. 6. TOOL-DRESSING FORGE FURNACE

same forges as readily as oil by changing the burners to those that are suitable.

The most important thing is to see that they are properly installed, as the air and fuel pressures must be steady, uniform and voluminous enough to give the forges their proper temperature and maintain it at the point desired. This, of course, varies with the kinds of material to be heated.

Where accurate temperature control is not necessary and pressure under 14 oz. will suffice, the steel fan or positive blower that will give the proper volume will maintain a uniform pressure. Where pressures from 2 to 5 pounds are required the positive blower is needed and when an air pressure above this is necessary the compressed-air plant will be needed. In some cases good dry steam will give better results and effect a saving in the fuel. The quantity of fuel needed varies with the temperature required, material treated and speed at which it is handled, but the fuel pressure must always be uniform. For the oil 5 pounds pressure is sufficient.

Burners

The burner to be used is an important factor in the economical production of work with these forges, and therefore it is not practical to have one burner that will do all kinds of work. Whether high- or low-pressure air, or steam is to be used for the blast, makes a difference in the kind of burner that should be used to get the greatest efficiency with the minimum fuel consumption, as well as the temperature that it is necessary to maintain in the forge, and the nature of the work that is to be done.

By Fig. 6 is shown a tool-dressing forge furnace that has been designed especially for shaping up lathe or planer tools or pieces of a like character and size, whether they be made of high speed or carbon steel.

FIG. 7. WIRE-BRAZING FURNACE

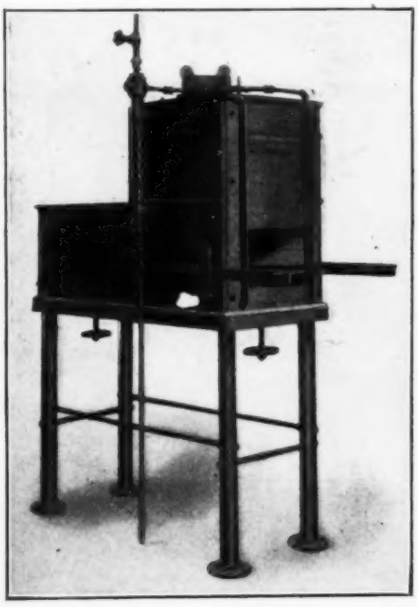


FIG. 8. TUBE-BRAZING FURNACE

Brazing Furnaces

The same company also makes a line of brazing furnaces, the types of which are shown by Figs. 7 and 8. Fig. 7 shows the wire-brazing furnace and the crank to the right operates a clamp that holds one wire. A clamp is also located on the opposite side of the furnace, so that the two wires can be held in perfect alinement if desired or the other wire can be held by the operator. A trolley wire can be brazed every three minutes with this style of furnace, the necessary heat coming out through a hole in the top of the furnace.

The tube-brazing furnace shown in Fig. 8 is designed for brazing brass, copper or steel tubes. The burner discharges a ribbon of clear hot flame from the top, down upon the tube, with an inclination toward the rear; the place to be brazed being near the front in full view of the operator. The bottom of the chamber may be raised or lowered to accommodate different sized tubes by the small wheels and screw underneath the furnace. Valves for controlling the temperatures are located at the operator's left hand and within easy reach. Thus the operator can regulate the fire to suit his work and draw the tubes forward without changing positions. The escaping gases pass out the rear end and warm up the incoming tubes, as well as making it comfortable for the operator by conducting them away from the front.

FIG. 9. GAS-FIRED LADLE HEATER

Heaters

In Fig. 9 is illustrated a ladle heater that is simple in design, does not take up much room and yet does the work perfectly. It can be used with either city or

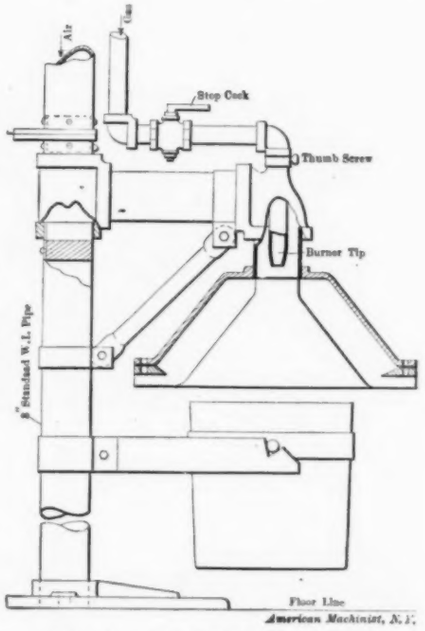


FIG. 10. GAS-FIRED LADLE HEATER

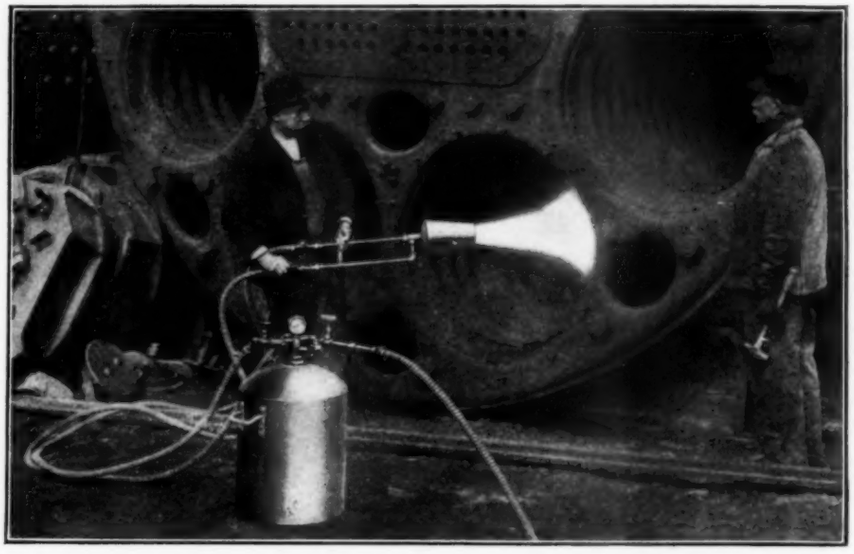


FIG. 11. PORTABLE HEATER AS USED ON BOILER REPAIR WORK

natural gas. Fig. 10 is a line cut showing the details of construction of the same.

The portable heater made by this company is shown in Fig. 11 as it is being used to heat the heads of rivets before cutting them off to repair the locomotive boiler shown. The pipe to the right of the tank supplies compressed air that is mixed with the fuel before it leaves the torch. This portable heater is useful in many ways and in this instance it effects quite a saving in time by heating the rivets before they are cut off, as they are tough and hard to cut when cold.

The Rockwell Furnace Company, 26 Cortlandt street, New York, are the makers of the above described forge furnaces and heaters.

Double Radial Drill for Boiler Plate Work

By I. W. Chubb

On page 396, of Vol. 32, Part 1, will be found an illustration and account of a German drill specially designed for drilling holes in locomotive firebox plates, etc. This machine is supported on feet at one end, and by a slide secured to the wall at the other.

As an example of a British method of dealing with much the same problem, the illustrations here given show a double radial drilling machine, which was made some little time ago by James Spencer & Co., Hollinwood, Manchester, to the requirements of Beyer, Peacock & Co., Ltd., locomotive engineers, etc., Gorton, Manchester. It is motor-driven, and carries a double set of spindles, 10 in all (see Fig. 1), while the German machine has six spindles, and is single only.

The Spencer machine was specially constructed for drilling holes in boiler and firebox plates, and admits plates up to 24 feet long by 10 feet wide. It is used, in fact, to drill five plates at a time, placed under templet. Two beds are employed about 30 feet long, having square edges,

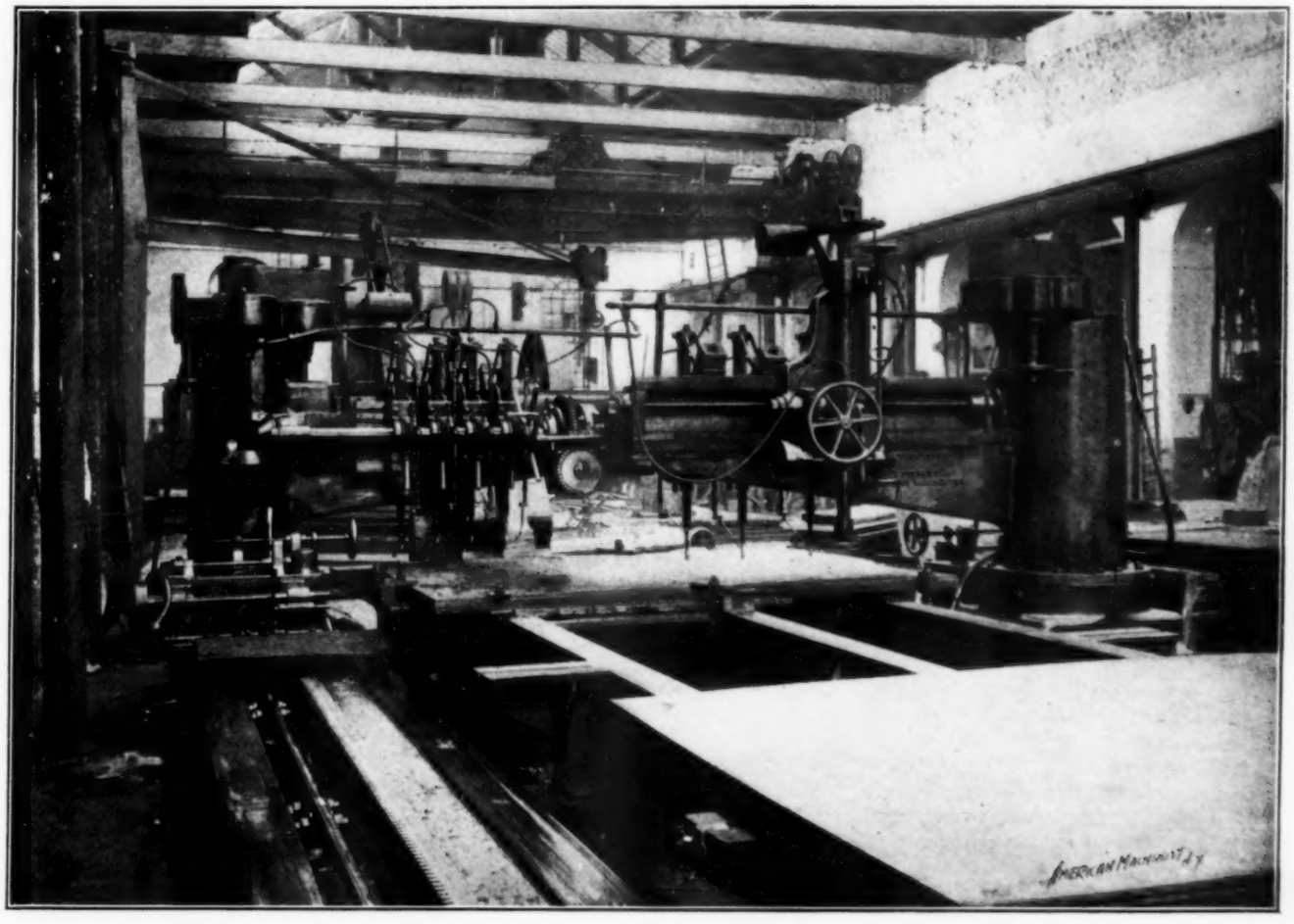


FIG. 1. DOUBLE RADIAL DRILL FOR BOILER PLATES, ETC.

3 feet 1 inch wide across the top, 1 foot 4 inches deep, and placed 9 feet 1¼ inches between the inside edges. These beds are connected by five cast-iron cross girders, each planed and T-slotted. On top of the cross girders are carried three longitudinal rolled steel joists provided with angle brackets for supporting the plates while being drilled. Then each bed carries an adjustable saddle and pillar, with radial arm arranged to swing in a complete circle, the jibs being 7 feet 11 inches long, so that the extreme radius of the outer spindle is 7 feet. The pillars are moved along the beds by rack and pinion, by hand and reversible power motion.

The larger spindles are for boring and trepanning, while the 2-inch spindles will cut 1¼-inch holes at a feed of 4 inches a minute. Each half of the machine is worked independently, and the outer spindles of each arm slightly overlap so as to cover the center of a plate 10 feet wide. The machine was designed for driving by 5¼-inch belt on 3-speed cone pulley, 19½ inches to 25½ inches in diameter, on a driving shaft which is carried down the center of each bed. As used, however, a 15-horsepower motor drives at the end of each bed. The makers, however, prefer a motor carried on a bracket attached to each pillar. All gearing is, of course, machine cut, and of steel where necessary, and the principal bearings are bushed with gunmetal.

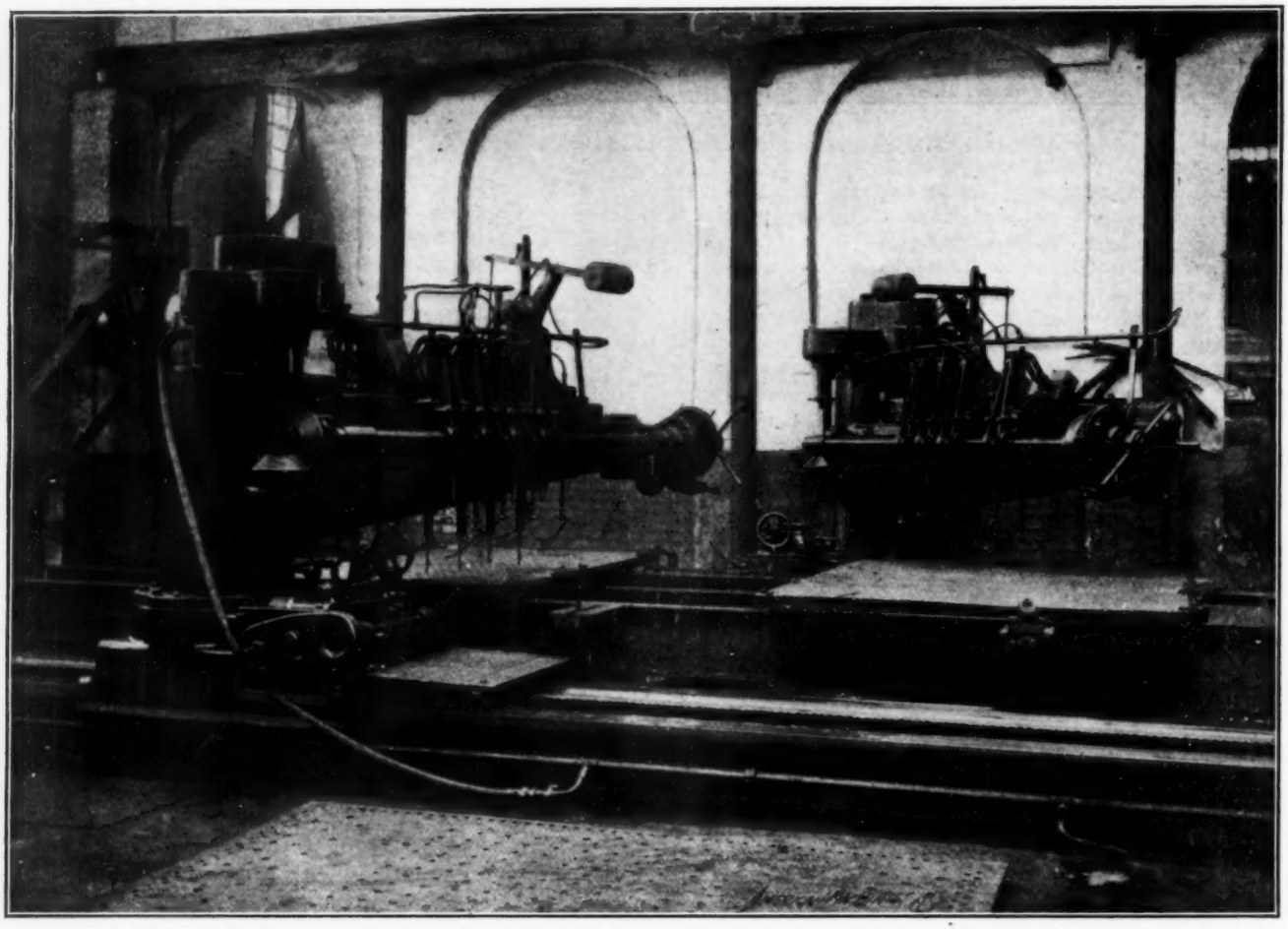


FIG. 2. ANOTHER VIEW OF THE DOUBLE RADIAL DRILL

Each arm has planed sides fitted with adjustable saddles. The front saddle carries four drilling heads, each with a steel spindle, 2 inches in diameter, the minimum distance between centers of spindles being 6 inches. Each spindle is balanced by steel-wire cord and weight, and has hand and self-acting feed of 9 inches by steel rack and quadrant, the self-acting motion being worked by double worm wheels and ratchet disengaging motion at the end of the arm. Ball washers take the end thrust. Each of these spindles is driven by equal gears and by long, quick-pitch steel screw (see Fig. 2) 3⅝ inches in diameter, 10 13/16 inches pitch, 14 threads, and gunmetal spiral wheels. The distance from the top of the longitudinal joists to the spindle ends in highest position is 2 feet 3 inches. The spindle ends are enlarged and have renewable steel bushes to receive taper-shank drills. Each arm also carries at the back a saddle and drilling head fitted with a steel spindle 2½ inches in diameter, having 14 inches range of feed, and driven through spur and bevel gear in the ratio of 4 to 1. This spindle slides in a cast-iron sleeve, which runs in a phosphor-bronze bearing, conical, with adjustment for wear.

Re-alinement of a Shaft with Conical Boxes

By John E. Sweet

In designing a lathe with boxes conical outside and drawn in a conical seat, the question came up as to how the shaft could be brought back into proper alinement when worn up or sidewise. The correct thing to do is to monkey with the headstock; but in this case that is not feasible, nor would it be in the case of most American lathes: so this scheme presented itself. Put the worn box on a true mandrel and redress the outside and draw it farther in the seat. This might necessitate the cutting a little off the small end or the wrapping of paper around the outside. This by some might seem bad practice but it is what wise sellers advised, and we never seem to question whatever the sellers do.

Some Interesting Chucking Work

By John Goetz

The following illustrations show some of the methods used in the chucking department of the Kempsmith Milling Machine Company, Milwaukee, Wis., and which seem to attract considerable attention from visitors.

The first operation of turning a bevel-gear blank is shown in Fig. 1, where the piece of stock is delivered to the machine cut off at the right length and held in a chuck for turning up the hub. An allowance of 1/32 inch in length is made for finishing.

The machine is a plain turret lathe with the tools shown bolted to the faces of the turret. The tool-holding fixtures allow the use of full-sized lathe tools, ½ by 1 inch in section and made of high-speed steel. These can be readily adjusted so that the cutting points will come opposite. Tapered steel wedges having fine teeth which engage similar teeth in the holding fixture enable the adjustments to be readily made.

These side tools reduce the stock from 3¾ to 2⅜ inches in diameter, for a distance of 1 13/16 inches. The blanks are then drilled and reamed, the first operation taking 8 minutes in all.

Fig. 2 shows the same blank reversed in the chuck and having both the face and the back angles turned by the two tools shown in the cross slides. This completes the roughing of the blanks, this end requiring an additional 2 minutes for chucking and turning. The blanks are now key seated if this is required, or a 5/16-inch hole drilled in the end for driving while being finished.

A Novel Method of Driving the Work

A chucking piece *A* is screwed on the nose of the lathe spindle, its front end being bored to a taper and having a key way cut for holding and driving the arbor *B*. The tapered hole can be easily ground true at any time, and insures perfect alinement for the arbor. The blank to be finished is held in place on the arbor by the nut shown and driven by the key, while the end of the arbor runs in the hardened bushings shown in place, and in practice is held in the shank of the finishing-tool fixture *H*. The tool in *H* finishes the hub to within a grinding allowance of 0.015 inch and the forming tool *F*, operated by the cross slide, finishes the face and back angles of the blank. This requires 3¾ minutes, making a total of 13¾ minutes for the whole blank.

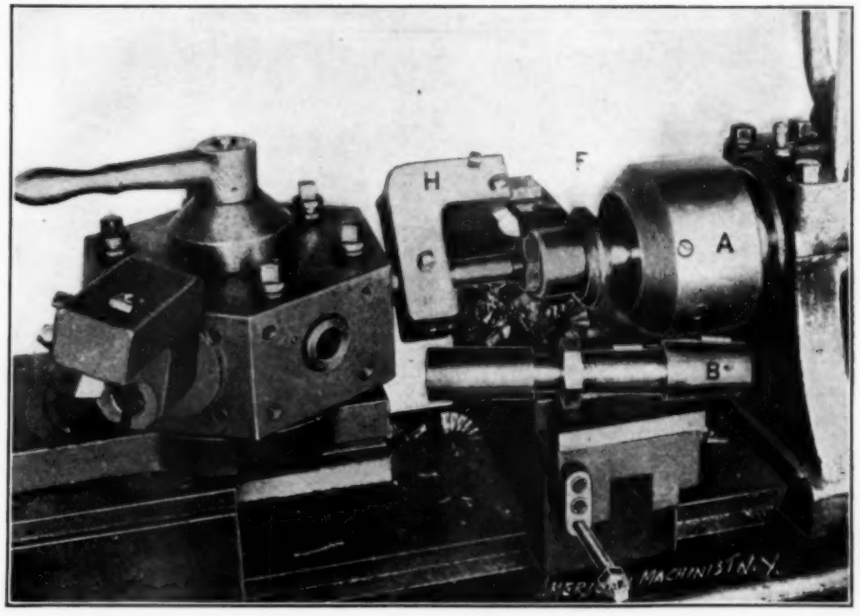


FIG. 3. FINISHING THE GEAR ON AN ARBOR

Making a Center Clamp Block

In Fig. 4 is seen the first operation in making a milling-machine center-clamp block, which is of cast iron. This is chucked by the hub and rough bored with a four-lipped high-speed drill *D* which also acts as a pilot to steady the turning tool *H* during the rough turning. The hole is first rough bored at a high speed, and the speed then reduced for turning the outside diameter with the tools shown. These are rough forming tools fastened in the holder *H*1. The turret is then turned to the next position, which is the three-lipped finishing drill *D* 1, after which it is reamed. The piece is finished by the tool in *H*2, which is supported by a pilot running in the hole which has already been drilled and reamed. The total time is 9½ minutes.

In the next operation the center block is chucked on the straight portion, as shown in Fig. 5, in soft jaws which are trued for this purpose. These tools have pilots

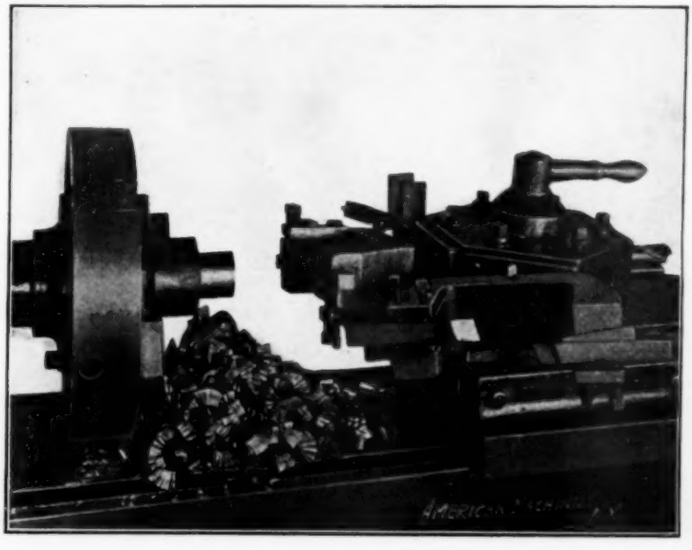


FIG. 1. FIRST OPERATION BEVEL GEAR BLANK

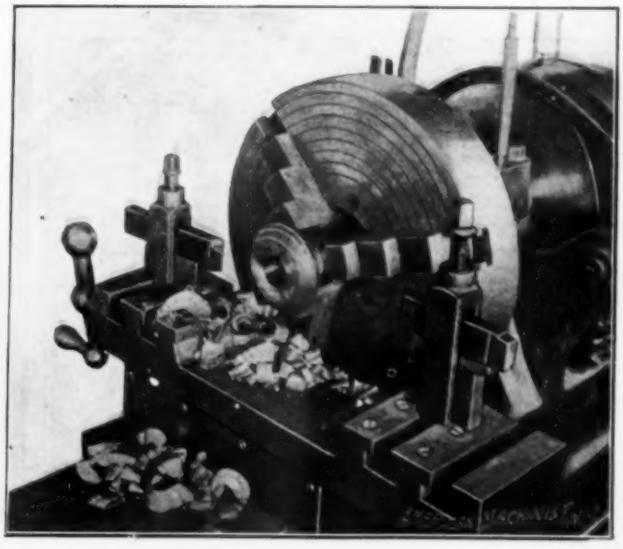


FIG. 2. TURNING THE OTHER END

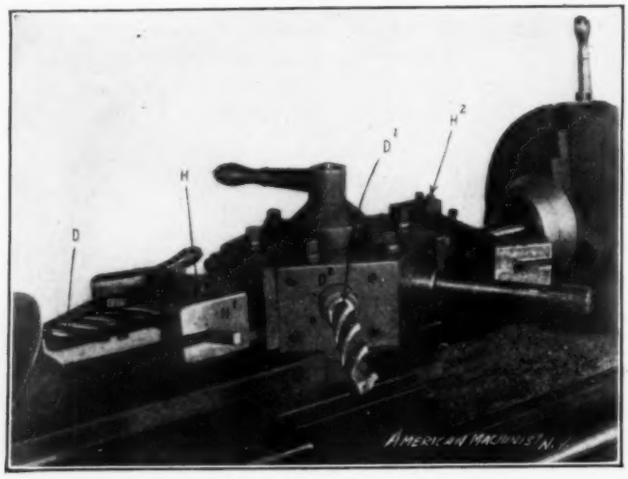


FIG. 4. TURNING A CENTER CLAMP BLOCK

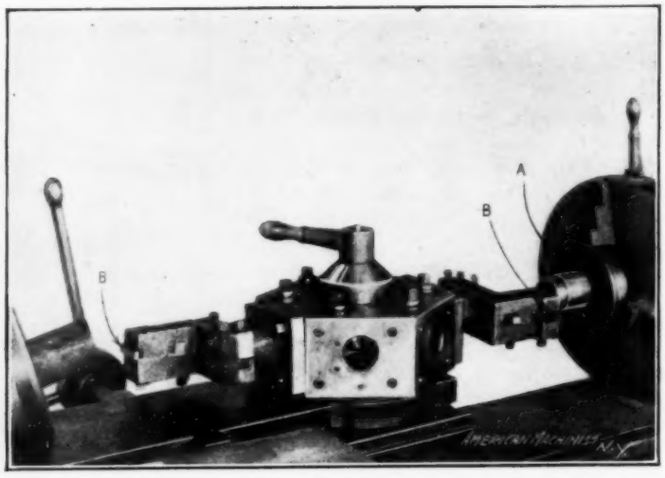
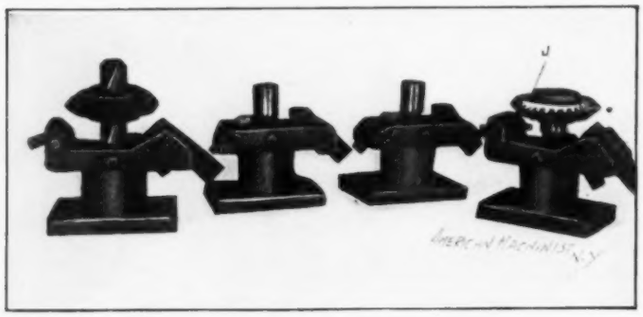
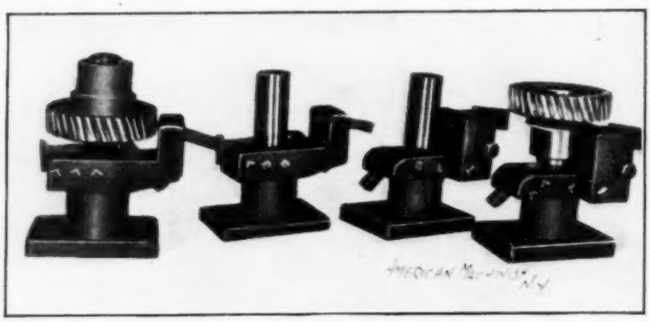
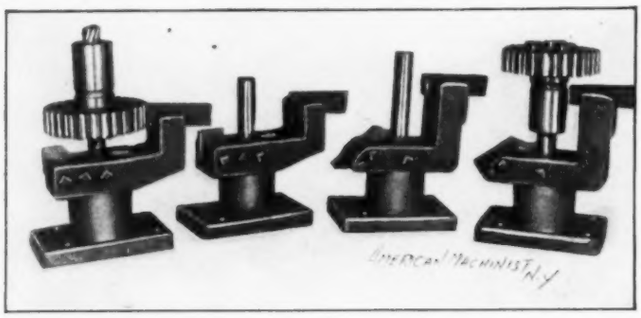


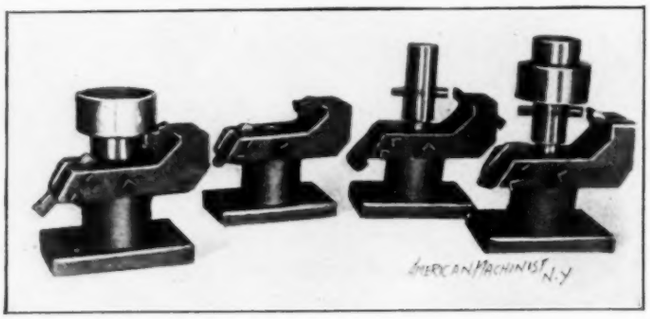
FIG. 5. TURNING THE BACK SIDE







FIGS. 6 AND 8. TOOLS FOR BEVEL AND SPUR GEAR BLANKS



FIGS. 7 AND 9. TOOLS FOR WORM GEARS AND COLLARS

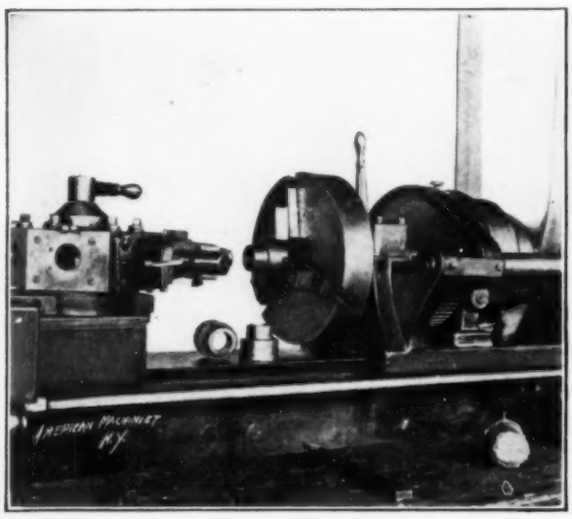


FIG. 10. THE SLEEVE TOOLS IN USE

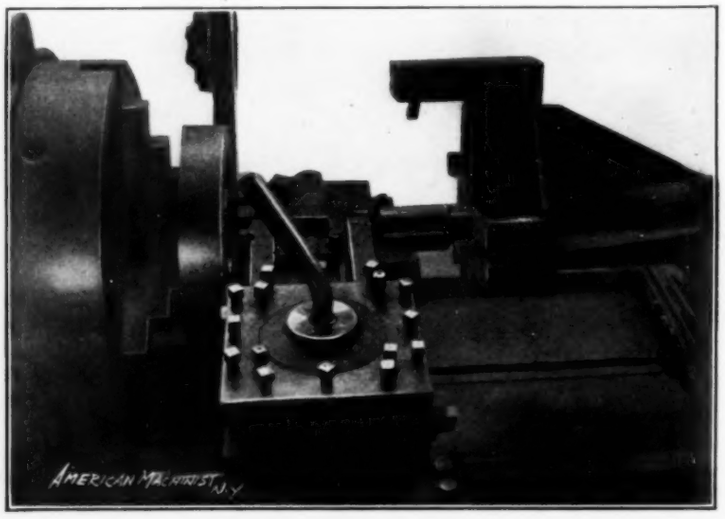


FIG. 11. GEAR BLANK TOOLS FOR A GISHOLT LATHE

for holding them steady while in the work, although these pilots are not shown in the illustration. A roughing cut is taken by a tool in the cross slide, after which the work is all formed by the cutter shown. This operation takes four minutes, making a total of 13½ minutes for the piece.

Fig. 6 shows the tools used in finishing the bevel-gear blank, shown in position at the left and right. These need little explanation, except to point out that these gears have a three-jawed clutch milled across their face and are 3.641 inches outside diameter. They are finished, including chucking, in 9 minutes each. Parts finished in this way are afterward put on an arbor and turned between centers in an engine lathe by using right- and left-hand facing tools and facing one end at a time. These tools are kept in the tool room and kept in good working condition by the toolmaker ready for the operator at a moment's notice. They require no setting up, except bolting to the hexagon face of the turret.

Groups of Box Tools

Fig. 7 shows similar tools for a worm gear, Fig. 8 for a clutch spur gear, Figs. 9 and 10 for a sleeve. These require no explanation after seeing the tools and the way in which they are made.

Fig. 10 shows a gear blank in a Gisholt lathe, the cross slide being used to rough turn the diameter and rough face the front side, while the hole is being bored with the bar; the hole is afterward reamed. The finishing tools are held in a rigid tool holder heavy enough to prevent vibration and are held central with the work by the pilot shown. The tools are never taken from these holders, except for sharpening by the toolmaker, so that they are always ready and the expense of setting up is very materially reduced.

It is estimated that the result of the first year's working of the British patents act has been that $2,500,000 of foreign capital has been introduced into the United Kingdom. It is stated that 24 firms are already manufacturing in England as a result of the act, and that a large number of German and American firms are in negotiation for sites and factories.

A Gearless Positive Speed Changing Device

By Henry M. Russell, Jr.

The accompanying illustrations, Figs. 1, 2 and 3, show a movement which gives two positive speeds forward and one speed backward without the use of gears. The forward speeds are a direct drive and a 4 to 1 reduction and the reverse is a 3 to 1 reduction. The device is applicable either to automobile or marine work. The operation is similar to that of planetary gears.

Referring to the cuts; Fig. 1 is from a photograph of the drive, Fig. 2 is a longitudinal section of the entire mechanism, and Fig. 3 is a cross-section along the line 22, on Fig. 2. The parts are for clearness shown in different relative positions in the two figures. Similar numerals refer to similar parts in both views.

The numeral 4 designates an outer case made up of two cylindrical portions of different diameters, which are separated by a center wall; 5 designates a shaft supported in the bearing 13, which is rigid with the case 4. The shaft 5 carries a two-throw crank 16, the pin portions of which have their center lines at equal distances on opposite sides of the center line of the shaft 5 and parallel thereto. Numeral 6 designates a member which has a cylindrical portion that is supported by the case 4 in its center wall in such a position that the center line of the cylindrical portion of 6 is offset from the center line of the shaft 5 the same distance that the pin portions of the crank 16 are offset from the shaft 5. That is to say, the bearing 14 is in such a position that, if the crank 16 be rotated the center line of each of its pins shall coincide with the center line of the bearing 14 once in each rotation. Numeral 12 designates a shaft supported by a bearing 15 at the opposite end of the case from the bearing 13. The shafts 5 and 12 are in alinement. Shaft 12 carries a spider 7, the arms of which are turned up at their extremities and the pairs of arms are connected, respectively, by double cross-bars 20 and 21, these bars include between them diametrical slots. Member 6 is formed at one end into a similar spider with pairs of cross-bars 18 and 19. At its other end 6 carries a crank 17 similar in shape and dimensions to crank 16. Blocks 8 and 9 turn upon the pins of the crank 16 and slide in the slots between the cross-bars 18 and 19, respectively. Blocks 10 and 11 turn upon the pins of the crank 17 and slide in the slots between the cross-bars 20 and 21, respectively. The numeral 22 designates a counterweight intended to balance 6.

It will now be apparent that the various members are still free to rotate upon their respective axes but that the connection between them is such that if the case be held still and the shaft 5 be rotated, 6 will be rotated at half the speed of shaft 5, and 7 will be rotated at one-fourth the speed of shaft 5. If shaft 12 be held stationary and shaft 5 be rotated case 4 will rotate at one-third of the speed of shaft 5 but in the opposite direction. The movements connecting the various members are similar to the movements used in machine for drawing ellipses and known as ellipsographs. These machines consist of two crossed slides at right angles to each other and a beam pivoted to two blocks, one of the blocks travels on each of the slides. If the tracing point be set at the middle of the beam it will trace a circle. If now the frame of the machine be supported so that it is only free to rotate about an axis perpendicular to the slides and the tracing point be rotated but allowed no other movement the frame of the machine will rotate half as fast as the tracing point is rotated. By two similar movements of this nature I can drive a sprocket, for example, which is alined with shaft 12, either forward or backward, and drive it forward at either of two speeds.

It will be seen that all the movements are simply rotative and that there are no reciprocating movements which might cause noise. It will also be seen that the sliding movement between the blocks and the slides is least at the point where they are transmitting the most power. It will be seen further that the lower pin of crank 16 and the higher pin of crank 17 are always the ones that are in action. This makes the line of reaction pass through the bearing 14 and obviates any serious twisting strains on that bearing.

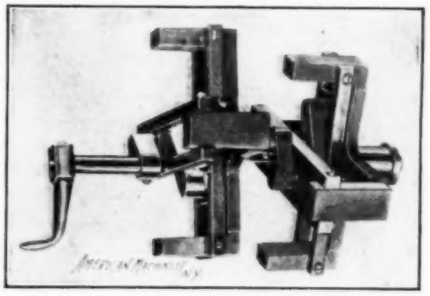


FIG. 1. A GEARLESS POSITIVE SPEED CHANGING DEVICE

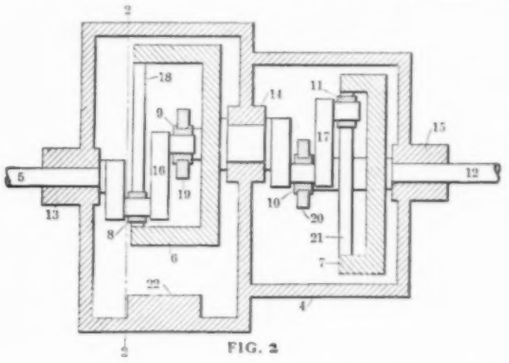


FIG. 2

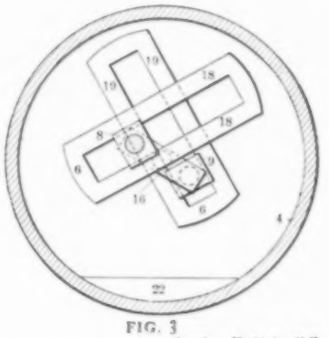


FIG. 3

American Machinist, N.Y.

SECTION OF GEARLESS SPEED CHANGING DEVICE

Practical Letters from Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

The Ethics of Memorandum Making

There has been a number of articles at different times in the AMERICAN MACHINIST on the card-index system of filing records, notes and cuttings, and I, in common no doubt with many other of your readers, have adopted that plan. The practice of memorandum making does not, however, seem to have been exhaustively dealt with.

Is memorandum making a salutary practice? If so, what is the best way to go about it? I should like to exchange views with AMERICAN MACHINIST readers on these questions.

For memorandum making I carry a six-page leather case. It measures 5x3¼ inches and goes easily in the breast pocket. The leather folds over each page top and bottom, forming flaps under which the paper is inserted. This size takes conveniently 3x5-inch record cards which I get for 9d. per 100; being stiff they keep their position better than paper and as I use both sides they don't come expensive. The leather flaps are headed SHOP, FILE, MAIL, CASH, TOWN and one blank. This form of case is not my idea and for aught I know may be on the market, but I have never seen it for sale and had mine made specially. For convenience it beats everything else I have tried; there is no carrying about of dead matter nor searching through pages as in a book; each item is classified. The case can be spread out on a table and all its contents exposed at once; filled cards are easily replaced.

But all this, Mr. Editor, raises a disquieting thought and brings me back to my first question, does or does not the habit of note making weaken a man's memory? I maintain not, arguing that the mere writing of the note so impresses it on one's mind, that it is often unnecessary to refer to it, although the knowledge that it is recorded relieves the mind, enables one to put the idea as it were at the back of one's brain and bring the mind to bear upon bigger problems. My lady friends on the other hand warn me that if I continue the habit I shall lose the power of remembering anything. I smile a superior smile, but all the same I have my moments of doubt and should like to know the experience of some of your note-making readers.

Personally, to scheme out anything without a pencil and a sheet of paper handy, I find almost impossible. I perhaps do not use these aids to thought, but their absence paralyses my faculties; I wonder how far this feeling is common to others of your readers. Of course, we know that women carry everything in their heads. No one ever saw a womanly woman making notes. If I saw such a phenomenon I should suspect her of being a man in disguise. She would rather remember that she owes the baker a half-penny and that the milk was half a pint short the day before yesterday than buy a penny note tablet.

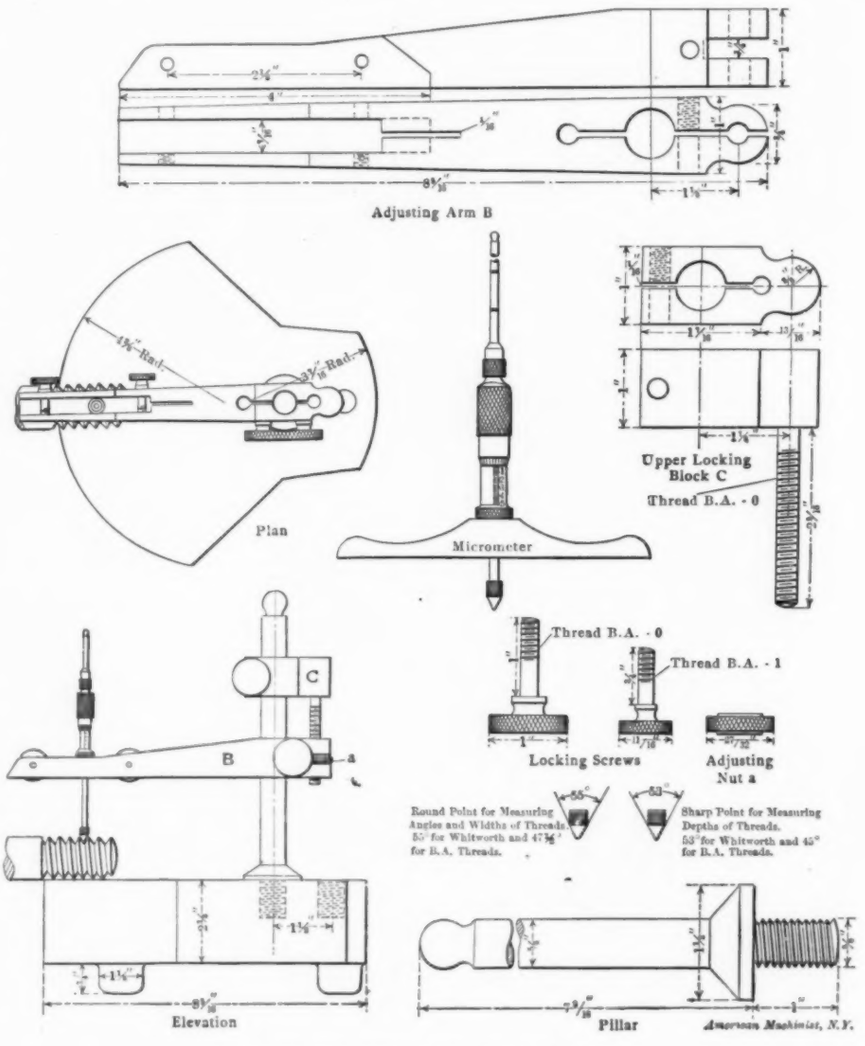
Various theories have been put forward as to the reason why women look old sooner than men; here we seem to have the true one.

Leicester, England. GRAPHIC.

Device for Measuring Thread Gages

Having a number of Whitworth and British Association thread gages to make, I found the instrument shown in the accompanying sketch of great service when measuring the depths and angles of the threads. As I have not seen anything like this in the AMERICAN MACHINIST it has occurred to me that it may be of some service to our friends interested in the gage line.

In using the device a standard plug gage, the diameter of which is the same as that of the screw to be measured, is placed in a micrometer and the adjusting


Adjusting Arm B
Plan
Micrometer
Upper Locking Block C
Thread B.A. - 0
Thread B.A. - 0
Thread B.A. - 1
Locking Screws
Adjusting Nut a
Round Point for Measuring Angles and Widths of Threads. 55° for Whitworth and 47½° for B.A. Threads.
Sharp Point for Measuring Depths of Threads. 53° for Whitworth and 45° for B.A. Threads.
Elevation
Pillar
American Machinist, N.Y.

DEVICE FOR MEASURING THREAD GAGES

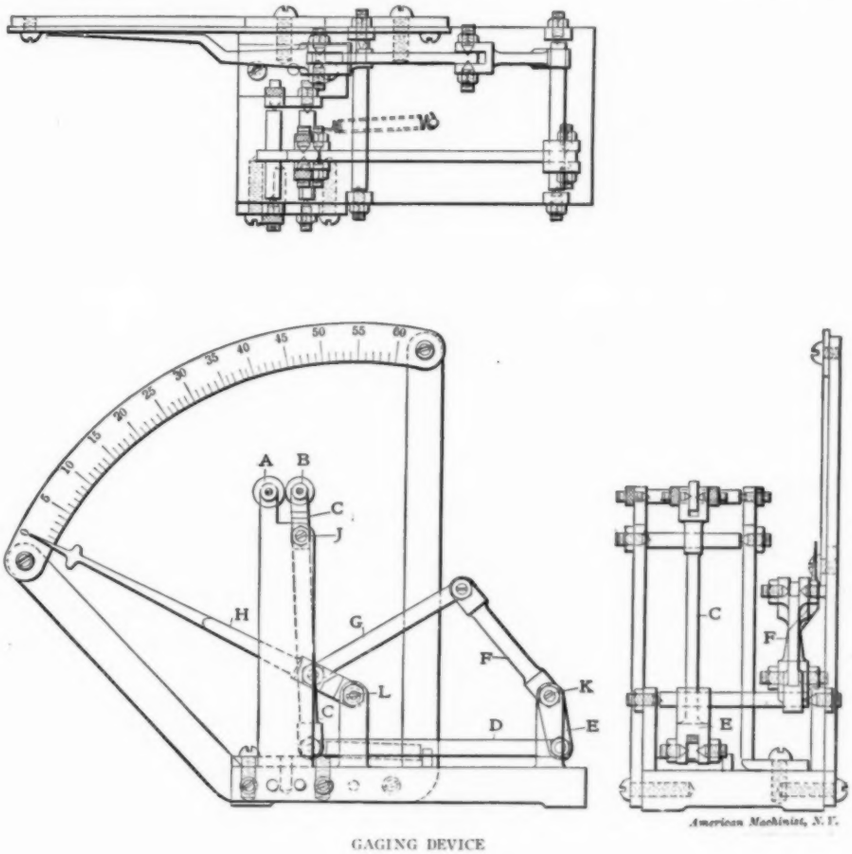
arm *B* is moved so that the point just bears with the micrometer gage set at zero. This adjustment is effected by turning the nut *A*. The plug is then removed and the depth measurement taken by the micrometer, using the 53-degree point for the Whitworth form of thread and 45-degree point for the British Association thread.

The widths and angles of threads can be measured by using the 55-degree point for Whitworth and 47½-degree point for British Association threads. As will be noted, the point for measuring angles and widths of threads is rounded while that used for measuring the depths of the threads is sharp.

Davenport, England. A. T. SUTTON.

A Gaging Device

The drawing shows an accurate and efficient gaging device. By glancing at the scale, it will be seen that its capacity for measuring is from 0 to 60 thousandths.



GAGING DEVICE

It was designed for the rapid and accurate sorting of round mica disks which are used for insulating purposes. Some idea of the time saved by this instrument can be obtained when it is stated that these disks are used by the thousand.

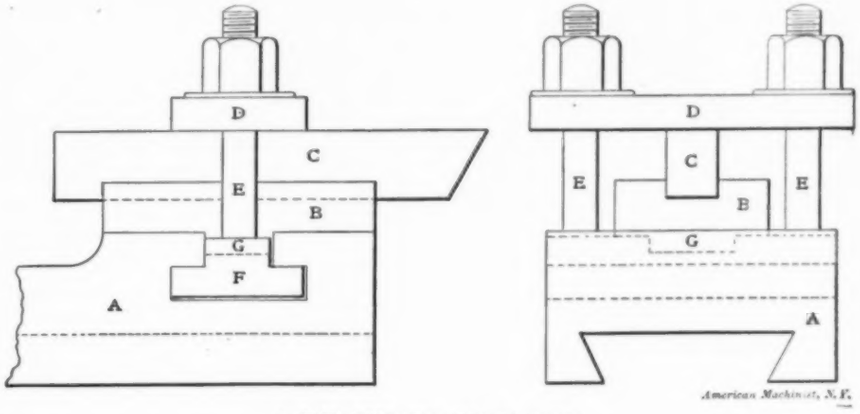
The tool itself is simple, consisting of a machine-steel base, three sheet-steel brackets, scale, six tool-steel levers (including the needle lever) and two tool-steel rollers 7/16 inch in diameter and 9/64 inch thick. There are four shafts which turn on pivot bearings, that is, on headless pivot end screws which are set to a lapped point in the shaft. These are adjusted by a hexagon nut. The levers are connected in the same manner, thereby insuring sensitive yet positive movement.

The roller *A* is fixed, being machined on the shaft. The roller *B* is pivoted to lever *C*. Placing the piece which is to be gaged between the rollers *A* and *B* will cause roller *B* to move to the right, and lever *C* to swing on the fulcrum *J*. That part of lever *C* under *J* will swing to the left, rod *D* and lever *E* following. Lever *E* swinging on the fulcrum *K* causes lever *F*, whose axis is *K*, to swing to the right. Part *C*, following lever *F*, operates the needle arm *H*, which swings on the fulcrum *L*. ARTHUR F. CASTONGUAY.

Bridgeport, Conn.

A Tool Post for Heavy Work

The line-cut shows a modification of the English tool post, which can be applied to the regulation American tool



A TOOL POST FOR HEAVY WORK

slide in place of the ordinary tool post. The tool post was designed by A. J. Clarke and used by him at the Boston Forge Company, East Boston.

A is the tool slide. The piece *F* fits in the T-slot from end to end. The two studs *E* are for the sake of strength made of nickel steel. The block *F* is recessed at *G* to accommodate a tongue in the block *B*, which is recessed on top to receive the tool *C*. This keeps the tool from turning under pressure of the cut. The clamp *D* secures the tool firmly in the block *B*. In the tool post I saw the slot on top of *B* was much wider in proportion and was intended to take a square heavy boring bar when the compound rest slide was set parallel to the bed. When using the turning tool a liner was placed alongside the tool to fill the slot.

New York. E. A. DIXIE.

Locking Screws in Place

I submit the following as a great help to users of air motors and more particularly to those machinists having to make ¼-inch screws in a 16- or 18-inch engine lathe with nothing but ordinary hand dies.

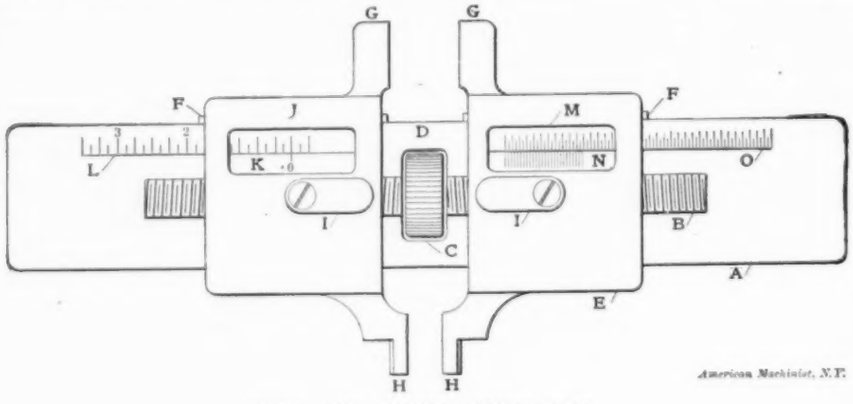
We all have our troubles to keep screws in the lower cover of our air motors. To overcome it, leave the heads ⅜ inch long and drill a 3/32-inch hole close to the shoulder. Then put your slot for the screwdriver in to the usual depth. After the screws are in place run a small steel wire through the holes and when through all of them fasten the two ends together. It is obvious your screws will not turn far.

We have had our motors come in with but one screw in the cover and the balls everywhere except in the ball race.

St. Thomas, Ont. MACHINIST.

Inside and Outside Caliper Gage

A tool that is much needed by the toolmaker is a caliper that will measure both inside and outside at the same time, that is, when it is set for one it is also set for the other. The one here shown I made a few months ago and for accuracy and convenience it is far ahead of anything I have seen for the purpose. It consists of a bar *A*, one-quarter inch thick, one inch wide, and six inches long, which bar has an opening *B* running lengthwise and another one *C* running across in the center into which is fitted a right- and left-hand screw *D* with a nurled head, the shoulders of which fit the cross opening in the bar. On the bar are two sliding heads *E E* arranged with spring keys *F F*, to hold the heads steady and friction-tight. The heads both have jaws *G G* for outside and *H H* for inside measurements; these jaws are ⅛ inch thick and the pair *H H* are ⅛ inch wide with one side rounded. When these are closed together they will exactly fit a ¼-inch hole, at the same time jaws *G G* will measure ¼ inch apart. These jaws or extensions are practically the only wearing parts on the caliper, and are hardened and ground to size. Nuts *I I* engage with their respective screws and carry the heads from or toward each other according to the direction the thumb nut is turned. There is an opening *J* in one of the heads; one side *K* is beveled and on the beveled surface is a line which tallies with the graduations *L* on the bar for plain reading.



INSIDE AND OUTSIDE CALIPER GAGE

In the other head is another opening *N* also with a beveled surface on which are vernier graduations, which with the graduations *O* on the bar enable the user to set the instrument to read in thousandths of an inch.

It is very simple to operate; if it is desired to turn a shaft or plane a piece to fit a hole or channel, set the jaws *H H* to fit the hole or channel and you have a caliper ready set for the part to be made.

The caliper is a convenient size and the nurled adjusting screw is easily manipulated with thumb and finger.

Dayton, O. H. E. Curtis.

Saving the American Machinist

Personally, I believe the clipping idea is not advisable with those who regularly read and are truly interested in the American Machinist. Clipping is excellent for extracts from magazines or papers which, as a whole, have no further value to the reader; this does not apply with the American Machinist. The publishers have taken so much pains to page and number their paper to facilitate binding that we should take advantage of it. By so doing it is easy to refer to a back number for information which did not interest us when first read, but is brought into prominence by a contributor's reference.

There is no room for argument against the binding of volumes by the bookbinder and most of us intend at some time to have them preserved in this way—just as soon as we can get the cash to spare, but the getting of spare cash that we cannot find a dozen uses for, seems to be a will o' the wisp we can never grasp. In the meantime there have been various schemes proposed to keep the reading matter of the paper intact.

My plan is as follows: After I have read the current issue, especially the advertisements, I turn it face down on a table and pull off the back cover, which exposes the two wire staples holding the leaves together. Then, with a small screwdriver I straighten the staple ends and pull off the advertising pages until I get to the reading matter. I then carefully lift off the reading matter and lay it aside. Turning the remainder of the pages over, I insert the screwdriver under the front of each staple and withdraw it from the paper. I then insert the staples in the original holes in the reading matter and bend them over so that the ends lie flat against the back.

By this method each issue is kept intact, allowing it to be readily picked out and carried to the shop for use at any time.

To take care of each year's papers I have secured empty pasteboard boxes from the dry-goods store, of a size which will just take 52 copies and the indexes. These boxes keep the papers clean while stored away. Thus each issue is a unit by itself, and each year is contained in a single box 3 inches high. Surely we can find room in our storage for a pile of these boxes, and by this method the mechanical news of many years will occupy but little space, even if we cannot have them properly bound.

Just a word as to the clipping nuisance. I say nuisance, for anyone who has ever tried to preserve clippings with any system has found several snags in his path. First, there is the trouble incurred by finding half of an interesting piece on one page and the other half on the other side of the same leaf. Second, there is such a wide difference in the sizes of clippings that a uniform arrangement is hard to find. Third, almost any book form is awkward, the clippings being hard to classify and harder to find.

While my system is not ideal, it suits me better than any I have yet seen. I have a loose-leaf scrap book 9x12 inches, each page of which holds six columns of reading matter (overlapped). The pages come already gummed in six dotted rows. After cutting the clipping in columns ½ inch shorter than the page, I moisten the dotted lines and affix the clipping by pressing its edge firmly down on them, using but ⅛ inch of the edge of the clipping in so doing. This holds it firmly and the strong feature is that it admits of turning back the clipping to read the reverse side, or the clipping that is lapped under it. In this way a large number of clippings may be kept in a neat and orderly manner in a small space. Another advantage is that when you feel like taking a look through your clippings to review any information, you can do so without any sorting or other trouble whatever. New leaves may be added at any time and the loose-leaf arrangement admits of the grouping of kindred pages. With the book is an alphabetical index, and additional leaves may be obtained from the makers—the Ideal Specialty Company, New York City.

In this connection I might add that I have found that an excellent knife for cutting clippings may be made by sharpening the end of a 6-inch section of an old hack-saw blade, wrapping several layers of thick rubber tape around 4 inches of it to act as a handle. If the end of the blade is included in the section used, the hole therein will be found convenient to hang it up by.

Boston, Mass. C. Tuells.

The exports of heavy electrical machinery for the month of July of this year amounted to but $391,195 as compared with $523,355 for July of 1908, while the exports of electrical instruments for the same periods show an increase of $136,715, a gain in the total of the two items large enough to show that the export business is taking on an active aspect.

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

Thin Slitting Saws

If I were cutting the hosiery-machine cylinder slots referred to by A. Kirkland in "A Difficulty with Thin Slitting Saws," on page 219, I should not be bothered by the saw not cutting straight; all would be plain sailing but for the possibility of the following occurring:

The slots under discussion are 0.018 inch wide by ½ inch deep, and there are from about 14 to 17 to the inch of circumference. This gives a very thin land between two slots. No trouble exists here when the slots are fairly shallow, but when they are deep I sometimes notice a tendency for the saw when cutting a slot to push over the preceding land toward the preceding slot. The slots, however, would be straight, and regulating them back is easily done. But this is not the trouble experienced by A. Kirkland. His saws appear to have cut "drunken" slots. I have known results like this. They are very possible with a thin, dull saw of large diameter, and I hardly think the remedy he gives will stand long.

The Brown & Sharpe screw-slotting saws 0.018 inch thick are 2¾ inches diameter. The slots are to be ½ inch deep. Allowing ¼ inch for saw wear I should put it between collars 2 inches diameter. Keep the edge very keen and do not crowd the saw too much. The time-honored cry, "Keep cutters sharp," applies to saws as well as gear cutters. Clearance on the saw is indispensable. Both sides should be ground hollow. By cutting on these simple lines no trouble should be experienced.

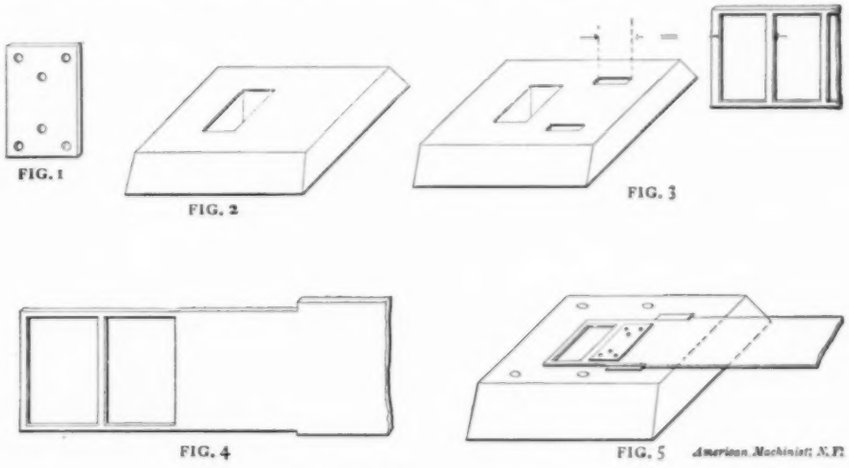
ERNEST MEE.

Loughborough, England.

Self Registered Press Tools

At page 277, 1907, Part 2, there appeared an article upon a self-registered arrangement in press tools by O. D. Clerkenwell, and the accompanying sketches and description of the method of making these tools may interest your readers, as this style of tool requires different treatment from the ordinary press tool, especially where a number of small piercing punches are required.

For a washer die, no templets are required, as the blanking holes are spaced off in the die, but for other shapes, the cast-steel blank, Fig. 1, is first made. This templet has the pierced holes accurately spaced in it.



SELF-REGISTERED PRESS TOOLS

The die blank is first lined off by the templet, due regard being given to the proposed position of side cutters and amount of feed. The die blank, Fig. 2, is drilled, filed out, and the templet fitted. The holes for the side cutters, Fig. 3, are next drilled out. These side cutters can be placed any distance from the blank, providing that they are parallel with it, but it is the best practice to place them in front of the piercing holes or at the side, always allowing as far as possible for the strain upon the die in hardening. It must not be forgotten that the width of the side cutters controls the length of the feed, which is the width of blank plus one side of the scrap as indicated in Fig. 3.

These holes in the die are now transferred to the cast-steel guide plate and mild-steel punch holder and after the blanking and side punches are fitted, hardened and tempered, they are driven into the punch holder. The guide strips are now fitted, also the guide plate, and the tools are placed in the press and a couple of blanks knocked out as in Fig. 4.

On taking the tools out of the press, the stripper plate is removed and the portion of the stock that has been blanked is placed in the position shown in Fig. 5, (in which the guide strips are not shown) which shows the stock located by one of the blanks with half of its thickness in the stock and half in the die. The templet, Fig. 1, is placed in the other blanked hole and the piercing holes are located from that, the hole being drilled and reamed, after which the blank is hardened, tempered and ground up. The piercing holes are then transferred to both the guide plate and the punch holder, and afterward opened out to take the piercing punches, which, after being hardened, tempered and ground, are driven into the punch holder. The punches are all ground level, the stripper and guide plates placed in position and the tool is ready for use.

This type of tool is for use with a short-stroke press as the punches are never intended to leave the guide plate. These tools are of no use on thick or soft stock, as the expansion of the stock in blanking jams the stock between the guide strips. They work best on thin German silver, hard brass or similar material, where the stock will not expand too much in blanking.

H. HARRIS.

London, England.

Principles of the Gyrostat

Mr. McCabe's article on "Gyrostats," on page 482, is timely and to the point. However, when he makes the statement that the front wheel of a bicycle is a gyrostat which enables a rider to keep his balance "hands off" I must take exception. I might say that some time ago I saw a similar statement in another technical paper.

I will try and show why I think the statement is wrong. In the first place the generally accepted idea of a gyroscope or gyrostat is, as Mr. McCabe defines it, "a flywheel revolved at high speed." As a flywheel involves a rim of some weight, the bicycle wheel does not have either of the elements required by the given definition. The rim and tire only weigh between 2 and 3 pounds, and at 10 miles per hour—a high speed to round corners—revolves only about 126 revolutions per minute; thus its gyrostatic power is very small, so weak that it will not even keep

the empty or riderless bicycle upright if an attempt is made to run it down hill.

The real thing that enables a rider to keep his balance under the conditions given is the way the front fork is "hung," the mechanical design. It is a well known fact that it is much easier to ride some wheels hands off than others (which would not be the case if the balancing were due to gyrostatic action). I have ridden a number of different wheels hands off and the one I now ride is hung the best of any I have ever tried, enabling me to ride quite slow and still keep my balance. In the construction of this wheel the center line through the head or steering bearings strikes the ground about 3 inches ahead of the front-wheel brace. This, in reality, makes a 3-inch throw crank of the front fork which tries to turn just as soon as the frame is tipped to one side. The action of this I think must be plain.

Now the reason some wheels are easier to ride hands off than others is because this crank is either too long or short. If too long the wheel turns too sharply; if too short it will not turn at all when tipped. When going straight ahead the crank is on dead center, hence no tendency to turn in either direction.

Now, it is a fact that a great many riders cannot ride hands off, which would not be the case if gyrostatic force kept the balance. There is a knack which the rider must acquire which is this: In order to make this crank I have spoken of, turn, the center of gravity must be placed to one side of the center line of the frame. This the rider does by slightly throwing his weight to either side of the saddle. Thus, if the rider wishes to turn to the right he moves a little to left side of the saddle. This causes the frame to tip a little to the right, thus putting the center line of the frame or crank shaft at an angle to the line of gravitation, and throws the crank off center to the left, causing the wheel to turn to the right as the rider wished. The action of the wheel and rider is the same whether going in a straight line or turning a corner.

I do not mean by the foregoing to say that the front wheel is not a gyrostat. It is. But what I do claim is that the front wheel on a ridden bicycle has not enough gyrostatic force to keep the rider in balance. This claim I think Mr. McCabe will grant upon a little further consideration.

Geneva, N. Y. E. M. Long.

The interesting article by H. B. McCabe on page 482 gives much information concerning gyrostatic action, but fails to explain why these actions take place.

To most mechanics the gyroscope is a mysterious affair, the principles underlying its action being somewhat obscure and difficult to understand. With a little study, however, I believe the following explanation will make clear its action to all those who like to connect cause and effect.

Starting with Newton's first law of motion, that is, "A body in motion continues to move with uniform velocity and in a straight line unless acted upon by some external force to change its condition," we can reason the action out as follows: Imagine the periphery of the rotating wheel to be pierced with dovetail slots, as shown at *Z*, Fig. 1. Into each of these slots introduce a steel ball and arrange them centrally with the sides of the wheel. Now, when the wheel is rotating in a *fixed plane* there will be no tendency for the balls to move sidewise in either direction in their slots. Just as soon, however, as there is a change in the *plane of rotation* there will be a tendency for the balls to shift. Consider first one of the balls when it reaches a position exactly at the top. Its instantaneous velocity is then in the direction of the arrow *A B*, which is also the direction of rotation of the wheel. If, now, at the same instant the plane of rotation be changed to the position shown by the dotted lines, by rotating it about a vertical axis at *o*, the ball under consideration *will endeavor to continue in its original direction A B*. If free to move

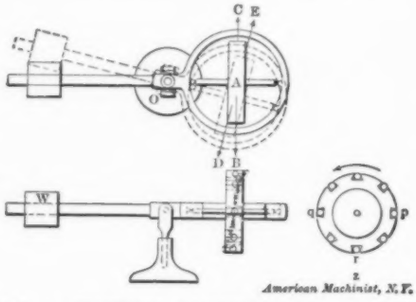


FIG. 1. DIAGRAMS ILLUSTRATING GYROSTATIC ACTION

in the slot it will move outward; if constrained it will still have a tendency to move outward and exert a pressure on the rim of the wheel in the direction *A E*.

Consider next the ball that is directly underneath. Its instantaneous velocity is exactly opposite that of the upper one, or along the arrow *A C*. With a shift of the plane of rotation, to the right as before, the ball tending to follow its original direction will move *inward*, or try to, and exert a pressure on the rim of the wheel in an opposite direction to that of the upper one. When the balls are in position midway between the upper and lower points, their instantaneous velocities are perpendicular to the plane of the paper, one being up the other down. A shifting of the plane of rotation about a vertical axis changes the position *but not the direction of motion* of the balls, hence there is no tendency for them to move sidewise in their slots and, consequently, no side thrust on the rim of the wheel. Following a ball through a complete revolution of the wheel we see that, beginning, say, at *p*, the side thrust is zero. It increases from there to the top where it reaches a maximum, decreases to zero again at *q*, increasing in the opposite direction to a maximum at *r* and decreasing from there to zero at the starting point.

These forces are represented diagrammatically in the side view of the figure.

Every particle of mass in the rim of a wheel may be regarded as a small ball and the sum of all their forces acting as already indicated forms a couple tending to produce rotation about the horizontal axis at *O*. As the figure is drawn, with direction of motions as there given, the effect will be to lift the weight *W*.

It should be kept clearly in mind that there are never any forces tending to lift or depress the wheel, or to set it in motion in any direction until there is a change in the direction of the plane of rotation and then such forces are at right angles to the direction in which such change takes place. As an illustration of this, referring again to the figure, the wheel can be balanced by the weight *W*. The arm supporting the wheel and weight is pivoted at *o*, so that it can turn both horizontally and vertically. With balance established and the arm at rest, a rapid rotation of the wheel about its own axis will not disturb the equilibrium, but as soon as the wheel is given a horizontal motion about the point *o* the weight will be either raised or depressed, depending on which way the motion is given. Or, again, if the wheel be given a motion in a vertical plane, there will instantly develop a force tending to rotate it horizontally about the point *o*.

Columbus, O. W. A. Knight.

What is Experience?

I read on page 190 an article under the above heading. This is a question which interests a good many of us. It hits me hard when the author tells me I might just as well have stayed in the old shop among my chums, doing the same things over and over again and trying to persuade myself I could do the other jobs if I had to, instead of traveling hundreds of miles and working in different shops. He says the specialist gets expert on one job, and no doubt could take hold of any other machine in the shop and *soon* do as well, meanwhile cutting circles round the traveler. Now it's just that little word *soon* that gives the game away. Who's going to wait while your specialist gets his hand in? Most people won't nowadays unless he's a young fellow working for low wages. People will not pay a man machinist's wages and teach him his trade at the same time. Even if it is all right to be a specialist, shops have a nasty way of going under just when they are least expected to.

One can easily imagine a specialist out of a job going to the "Practical superintendent with the big P" and asking for a job on the lathe.

"No lathes empty, but we have a vertical boring machine; have you ever done any?"

"No, but I read a good deal about it in the AMERICAN MACHINIST about two years ago and think I could manage it all right."

I expect the super would jump at the chance of getting him.

Entropy said a short time ago that there is no need for a fellow to settle till he is spliced. It's ten to one he'll have to shift a few times after and it's best to get used to it while one is young. There's more chance of getting a good berth by going about and looking for one than there is in waiting for dead men's shoes. And if one does nothing else one keeps out of the rut by shifting. Three years in a shop is my outside limit at present, and as much shorter as is convenient. I think if a fellow stays in one place a long time it's either because he puts other things before his desire to become a good mechanic, or else is afraid to move. I hope to travel a good many more miles in search of experience and bread and butter. I have a whole lot of AMERICAN MACHINIST clippings to take along with me, but I don't take the whole volumes as my luggage has to be as light as possible.

Romford, England. WAYFARER.

How to File Technical Papers

Technical papers if kept intact as received, or even stripped of advertising matter and bound, soon become bulky. In all papers there is a great deal of reading matter from which one gets a lot of good reading, but it is not of a nature that one would care to file away for future reference. To have such articles as one may have collected on a certain subject or subjects at one's finger tips is a matter of great importance.

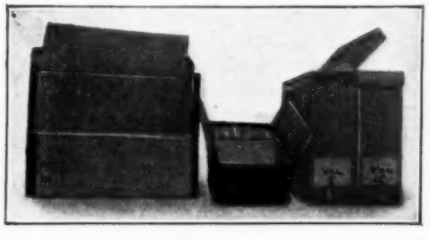


FIG. 1. THE FILES

Folder	Vol.	Boilers
81	2	Marine, Corrosion of
"	"	" Cleaning "
"	"	Temperley - Cockburn, System.

Folder	Vol.	Gearing
121	3	Spur - Speed of.
"	"	Interchangeable Involute Tooth
127	"	The Stub - Tooth Gear
49	1	Strength of Gear Teeth

American Machinist, N.Y.

FIG. 2. SAMPLE INDEX CARDS

Several years ago I adopted a method which to me has been very satisfactory, viz., a simple card index and three Library Bureau files 3¾x10¼x13¼ inches, which are like common letter files but more substantially made, being of wood nicely cornered (see Fig. 1).

In each of these files were placed 50 paper folders numbered consecutively from Volume 1, 1 to 50; Volume 2, 51 to 100, and Volume 3, 101 to 150. To various subjects most likely to be considered a certain number of folders were assigned. A number of unassigned folders were left in each volume for unlooked-for subjects of interest.

Sometimes there are two articles of an entirely different nature on the same page, both considered of enough interest to save for reference. This is easily taken care of by the card index regardless with which subject the sheet or sheets are filed. Fig. 2 shows the style of card used. It can be readily seen that it is but the matter of a moment to have all articles on a certain subject before one. To keep sheets from being misplaced they are numbered the same as the folder in which they are kept. As the volumes are filled new ones can be added and more folders assigned to any subject without disturbing the old ones.

It would simply mean that one would have to open two volumes instead of one to have all clippings on a certain subject, but the card index would look out for this.

Hartford, Conn. H. TERHUNE.

What is the Action of a Lubricant or Coolant on a Turning Tool?

The article on the above subject on page 335 awoke afresh in my own mind a wish that some further light could be thrown on this very interesting subject. The queries mentioned by your correspondent are quite an echo of my own, as I have stood by the lathe for hours watching the chips curling up and endeavoring to account in some theoretical way for the varying behavior of the metal under different lubricants, or without lubricant at all.

The first theory that I adopted was that the metal being cooled on the outside by the lubricant, or coolant, is made to contract there, and thus to curl up in such a manner as to considerably reduce the amount of metal in contact with the tool. This seems to go some way on the road; but water or sodawater could fulfil the conditions of this theory; but, as stated, they are inferior to oil. It follows, therefore, that something else takes place as well.

I am of the opinion with A. H. A. that the oil penetrates to the tip of the tool, and is caused to go through by the splitting of the metal in front of the tool point, thus leaving a space into which it is forced by atmospheric pressure.

This theory was formed on seeing a specimen of a steel rod in which the fracture was visible in *advance* of the tool tip, and the distortion of the metal can be seen for some considerable distance in advance of tool when examined under a good microscope. This specimen was shown at a meeting of the Institute of Automobile Engineers, by Professor Rosenham, of the National Physical Laboratory, on the occasion of a paper which he read, on the "Strength and Structure of Alloys," in 1906 or 1907; a clever feature was the way in which the shape of the fracture was preserved. This was done by copper plating the specimen to a considerable thickness before it was cut and etched, a clear true section through the fracture being plainly visible. Although it was not in connection with the subject of lubrication that the specimen was shown, it would be interesting to know whether this gentleman has since made any investigation on that account, or in the direction of recutting angles for tools.

The fact that an oil of considerable viscosity, that is within reasonable limits gives better results would probably be due to the viscosity varying with the temperature. An apparently high viscosity oil when heated at the tool possesses less viscosity and is able to penetrate to the cavity in front of the tool. It would seem probable that an oil having less viscosity might evaporate or disassociate before reaching the tip, owing to the high temperature and, therefore, prove less efficient.

The theory advanced here seems supported by the behavior of other metals, such as brass, for example. Here I assume that a lubricant is used solely for cooling purposes, as brass offers little surface frictional resistance to a steel tool. On cast iron the metal breaks away and does not bear on the tool in the same sense as a steel turning does, and a lubricant is not necessary. On aluminum a less viscous lubricant is proved superior, as the cutting speed is higher and, therefore, it has less time for evaporation or disassociation. These are all lathe conditions. The conditions on a milling cutter would be quite different, as the cutting edge is only buried in the metal for a short time

and is able to take its own lubricant with it. I trust that further information will be forthcoming on this very interesting query.

Sheffield, England. R. B.

Constructive Imagination—Machine Lubrication

There is an expression at page 316 which is particularly worth notice. It is that concerning the Wright Brothers' engine, which is said to "seem to run in their minds." This exactly fits the ideas of, I have little doubt, very many of us. A machine must run in a man's mind if he is to understand it. In other words, a man requires to be able to form a mental picture of things he must understand. It is not always that a mental picture represents facts or even scientific accuracy. Nevertheless the picture must be there.

An artist's painting of a flower looks like a flower at a distance and is so like one that it is easy with the picture in mind to pick out the flower in the garden. But look at both flowers and picture through a microscope and a difference at once appears. The painting becomes a rough, irregular bit of crude and tumbled earth; the petal of a rose is seen to be a blended harmony of still finer detail than the naked eye can distinguish. But we must have our mental pictures no matter how coarse they may be.

Imagining Furnace Action

The idea has presented itself to me in respect of other things than mechanism. To grasp anything of smoke production and prevention and the combustion of fuel in a furnace a man must sit inside the furnace and watch the gases evolved by heat from the coal come pouring along under the brick arch acquiring temperature and gradually changing from dull non-radiating smoke into invisible gas. It is just as well that the student should leave his body outside and become what some people would term an astral body. The fire cannot burn his mind and it is in a sense quite possible to sit thus in a furnace.

Wright Brothers and other aviators have been able to see mentally the coming to earth of their machines and many of us, who believed flight to be possible, and I fear I was one of the number, did not see the easy possibility of coming to earth. But the re-contest with earth has not proved at all a serious difficulty and indeed the whole business of flying seems to be solved by the petrol engine.

The Blériot Monoplane

I went to see Blériot's monoplane when it was on view here after achieving a reputation out of preparation to the feat of crossing the Straits of Dover, simply because the water was salt water and there are people who regret that we live on an island and think we no longer do so. The Blériot machine was just like a headless flying fish, such as I have seen in the Indian ocean skimming along with outstretched wings. It had a paltry looking engine in front and a propeller like those wooden air agitators one sees so much in America for keeping air in motion in a room. The engine had gills on the cylinders. There were two wings spanning about 26 feet overall and having an area of 151 square feet. The whole thing looked about fit to carry a homeless cat.

Lubrication of a Cutting Tool

It has always been a puzzle to me how lubricant could find its way to the point of a cutting tool. I can only account for it by two things: First, capillarity and, second, by disbelieving that much cutting is done by the edge of the tool. It seems probable, if we will mentally ensconce ourselves at the cutting edge, that the metal cut is wedged open by the two faces of the tool which meet in the edge and that the opening is so far in advance of the edge that there is time for some lubricant to find its way to the edge. The advance of the metallic division ahead of the edge cannot be great or a dulled edge would not be so much less efficient than a sharp edge, once a cut has started. That it is less efficient seems to prove that there is something in a keen edge. Thus we do not seem to get much nearer to a solution of the lubrication problem.

Thick vs. Thin Oil

Some years ago a rather interesting question in lubrication presented itself. A set of pumps, driven by a worm and wheel, were required to be tested for general sufficiency. The worm was below the wheel and there was a thrust bearing in a narrow cylindrical recess out of the oil casing which inclosed the worm and wheel. A thick oil was filled into the casing and the test was made. The thrust bearing soon grew unbearably hot and it looked much as though the pump would be condemned. Quite suddenly the box went comparatively cool and no further heating took place. The cooling coincided with the thinning or liquefying of the oil. At first this was so very thick that it could not freely enter the thrust chamber against the tendency of the worm to draw the oil away from the thrust recess and pile it up to the opposite side of the casing. But this piling up ceased when the oil became hot and thin, for it could then get well into the thrust collars and these cooled at once and the test was declared good.

Now, here was a case where the contractor benefited by a long test which simply proved that the contractor's estimate of the thickness of oil required was incorrect. A thinner oil would have run cool from the start in all likelihood and this is confirmed by the experience of many, that a thin oil is a better lubricant than a thick oil up to the point where the pressure begins to squeeze the oil from between the surfaces. Presumably this explains the benefit of long bearings for they admit of the use of thinner oil without squeezing it out from between the lubricated surfaces.

Machine Lubrication

In cotton machinery I became aware many years ago that the spindles required more driving with the best sperm whale oil, which was considered the very best lubricant to be obtained, because it was free from jamming, than with a mixture of half sperm and half mineral. The use of the mixture on the spinning spindles appeared to reduce the whole power of a factory about 10 per cent. With the facilities offered today by electrical driving in the way of easy measurement of power there ought to be undertaken serious tests of lubricating oils in spinning mills. In the days to which I refer one could only indicate the main engine and get by difference the result of a change in lubrication. But with electrical driving a fresh oil can be tested on a single frame and the correct consumption measured in terms of, say, a million turns of the spindles. Then each different machine can be tested, for it cannot be supposed that the same class of oil will suit equally both spinning room and card room, and it might be found that it would pay to leave no lubrication to the attendants except, perhaps, that of the spindles and to employ special men to oil the machinery, using one oil for spindles and another for wheels and bearings.

Machinery lubrication is still very crude. Small oil holes are provided to take the point of a can out of which oil runs freely, and some of the oil does find its way into the holes, the rest falling on the floor where probably the bulk of the small parts lubricating oil of the world usually goes. Such oil is mopped up, but is rarely caught in drip tins and cleaned. A great economy should be possible with better lubricating devices, pads, wells, funnels, as needed.

The motor car is perhaps the worst case of oil-wasting machinery that we have about us. Rarely does a car stop but what it leaves a puddle of oil on the roadway. This may be ignorance and carelessness of drivers, so many of whom are hoggish in spirit. But it is also a fault of design, for every machine ought to be designed to suit the class of labor that customarily attends upon it. One trembles to think of the grease-bespattered condition of our dress when, to use the words of the comic song, "the pigs begin to fly," for they soon will begin to fly and to drop upon us oil, petrol, bits of castings, nuts, bolts and occasionally human bodies.

London, England. W. H. Booth.

The Production of Silent Speed Gears

John R. Godfrey, on page 190, Vol. 32, Part 2, says, "Taken altogether there is a lot yet to learn about gears, even among those who use them in large quantities and are interested in knowing what is what in gearing," and previously, "My acquaintances among the automobile testers tell me that nearly all their troubles come from the gears."

I can fully indorse both the above statements and, as my work has largely been in this particular branch for some years past, perhaps a short account of some of my experiences may be of interest to your readers.

One authority has stated with regard to speed gears that, in nine cases out of ten, any fault there may be is due to the cutting, and the tenth case to warping during hardening; personally one would hesitate to be quite so positive, and while faults of cutting still are a decided factor in noise production, yet they are not the only one; indeed the writer's experience is that, if the subsequent operations on a gear were carried through as carefully as the cutting usually is, noisy gears would be scarcer.

The commonest defects of speed gears are as follows:

(a) Inaccurate indexing; the index heads on most gear cutters are too small, the index circle being often less in diameter than the gear to be cut, thus any inaccuracy is magnified on the gear.

(b) Roughly cut teeth, due either to a dull cutter or one badly ground (that is, with one or more teeth higher than the rest), or to want of rigidity in machine or fixtures.

(c) Cutter not central, producing a tooth flatter on one side than the other; such a tooth bears high on one side, low on the other.

(d) Taper teeth, brought about by centers out of alinement, or a springy arbor. A badly ground cutter produces ridged teeth, with chatter marks every revolution. Stopping in the middle of a cut will produce a hollow, the cutter biting deeper when the machine is restarted. Too much stock should not be removed in the roughing cut, else punching or tearing marks may be left after the finishing cut is run through. A freshly ground cutter would invariably be used for the finishing cut; the maxim that sharp tools produce good work is especially true of the gear cutter.

To carry through a speed gear properly requires that every successive operation should be thoroughly thought out and carefully carried through, because that uncertain factor the human element comes in everywhere.

Annealing the Blank

The previous treatment of the blank is the first thing to be considered. Although some makers recommend that their steels should not be annealed, it does not follow that they are right. The correct procedure is to release internal strains, for nobody can say beforehand whether these will be regular or irregular; this can only be done effectually by first removing the skin in a lathe, then carefully annealing. This is imperative with forged blanks, but the annealing must be thorough. Warping during hardening is most frequently due to defective annealing, the piece is not heated enough.

Heat thoroughly and uniformly, slowly at first, then raise the temperature more quickly to near the critical point of the particular steel used. With steel alloys a much higher temperature than is commonly given is requisite to obtain anything like uniform results. Cool out very slowly, without access of air, either in quicklime or hot sand. When a quantity has to be made, or a new steel is tried it pays to run through an experimental piece, watching its behavior carefully throughout, also taking careful measurements before and after each heating.

All steel expands in hardening, especially in carbonizing, but *it expands in the lines of least resistance*. Therefore this expansion may, and often does, contract the bore of a piece rather than expand the periphery much; and so it gets called *contraction*. The behavior of a formed piece depends in a great measure upon where the thickness of metal lies. These are points that will bear watching.

Next, one has to consider the question of scale. Scale again is usually put down to what it is not, viz., burning. Call it rapid oxidation if you will, but not always burning, which presupposes overheating. Scale means hard points alternating with pits on the tooth surface, an irregularity usually translated into noise. Now scale should never be; it is easily prevented and, like most accidents, is due either to ignorance or carelessness. One never sees scale on files (which are generally hardened); therefore, if your hot gear *must* be brought into contact with moist air at an oxydizing temperature, why not protect the important surfaces with a good filemaker's paste to which has been added 5 to 10 per cent. of basic lead carbonate or sulphate; this forms an efficient screen and scale will then be a thing of the past.

Form and Angular Contact

The writer's experience is that the form of a tooth, as well as the angle of contact, within reasonable limits, matter very little indeed. One form is quite as apt to be noisy as another, or silent as the case may be. Some prefer a long tooth, others a short one; one has more material to wear away, the latter has the advantage in proportionate strength, and stands up better at high speeds. The vital point to make sure of is that the torque is taken up by successive teeth without "a solution of continuity," but the tooth with a perfect profile has yet to be generated. This means accurate spacing—dead accurate. Also it is as well to have the pitch as large as convenient; there will then be fewer teeth to rattle.

Allowances between pitch circles of more than 0.005 to 0.01 inch are devices of the mechanical evil one, and snares for the inefficient workman. If the gears are not right in the first instance, backlash will not help matters any, especially when, on the down grade, the automobile is driving the gears.

Inaccurate fitting, untrue tapers which give a wobble to the bearings, housings or bearings loose, shafts out of alinement with the driving sleeves, or not parallel, sliding gears loose on the shaft, these are all sources of noise.

Noise in the Gear Box

The acoustic properties of the gear box and oil screen beneath it have not hitherto received much attention from the designer. Indeed, just as architects are ignorant of ventilation and, on this side, our authorities are a French general, Morin, and two professors of medicine, Parker, of Netley, and Jacob, of the Yorkshire College, so it appears we must have resource to the physicist to design a non-acoustic box. The less air space there is in a gear box, and the more this is cut up by internal projections the better. The beautifully curved sides and roomy upper works for the gear-shifting mechanism are just so many sounding boxes. The torque rod sometimes transmits sound from the back axle, which is relegated to the gear box. This explains why speed gears sometimes run silently on the test bench and noisily in the chassis.

Locating Noises

On the test-bench this is far more easily done than when running on the road, though when two trains of gears are running with 5 or 6 gears in mesh, it is not an easy matter to pick out a faulty gear; one has to proceed by a process of exclusion, eliminating unlikely causes, and relegating each sound to its particular source.

At the first testing a speed case is usually run dry, or at most with a little tallow on the teeth. I prefer to use tallow for two reasons, for by its use the hardened teeth show bearing marks more quickly, and the noise, when running at say 1000 revolutions, is sufficiently modified to allow one to discriminate more readily its character and origin, than when running either quite free from or bathed in, oil. Furthermore it has been noticed that when a gear is run without tallow it is far harder to quiet down, than the one that is greased. I do not know the reason for this, probably some obscure molecular properties in the steel respond to the vibratory rhythm of contact. One is

so used to regarding steel as a solid, that it calls for quite an effort to think of it as a mass of vibratory molecules.

It is just in this kind of work that knowledge and judgment tells; not only must noise be exactly located but the meaning of each sound must be interpreted. If one sound persists through each train of speed gears, first, second and third for instance, it follows that the fault lies in one of the constants; by braking first one pair and then the other (a hammer handle held against the second motion shaft and reverse pinion alternately, answers quite well) one may learn which pair is faulty; to decide which of a pair is bad, watch the revolutions, the noise will synchronize with one or the other, and this observation is usually confirmed by the markings on the teeth.

A "nutcracker" sound is given when teeth are bottoming, either actually touching top and bottom or bearing hard below the pitch line. Irregular spacing produces a peculiar rattle which rises and falls once or twice during a revolution. One or two large teeth give a sharp, synchronic jerk. An irregularly expanded gear gives a sound similar to tight teeth when small. When the gear is larger, the sounds appear to reach a maximum every second or third revolution according to the tooth ratio.

Some gears, especially those whose web is not central, have a trick of warping in a very vexatious fashion, the rim falls inward in places around the periphery, producing a wavy pitch line, high in some places, low in others. In such gears the teeth bear at opposite ends and sides, sometimes at uneven hights. These gears are usually noisy, giving a double or triple beat each revolution. The noise from backlash can be detected by the fact that it rises and falls irregularly, usually coinciding with the pull and slip of the driving belt; it is especially noticeable during the "hunting" of shafting driven by a gas engine. The noise of backlash is about the only one which diminishes when the brake is applied. When teeth bear hard above the pitch line (flat teeth) the sound is similar to that produced by an irregular torque, but continuous, while irregular torque is synchronic. The noise from a roughly cut or scaly tooth may be detected by the fact that there is little or no noise immediately after the teeth have been tallowed, but after the first few revolutions the noise gradually increases as the coating of tallow is thrown off.

Other noises are due to faults apart from the gears, but as these are all preventable causes they do not concern us here, and must be heard to be recognized.

The Remedies Proposed

Many plans have been tried from time to time to remedy defective gears, all more or less costly, all more or less futile. Running gears in with emery and oil grinds good and bad alike, besides playing havoc with the bearings. Gear-tooth grinding machines are certainly a step in the right direction but, as yet, are only the beginning of better things. I have not yet seen a machine of this class that has not seriously interfered with the pitch line, and again they take too much off. Gear-tooth grinders in which the abrader travels over the work, and the travel is actuated by a crank, grind more off the ends of the teeth than the center. Naturally there are more revolutions at each end of the tooth than when the emery wheel is passing the center. When it is a question of expense, (and when is it not?) the machine wins every time; yet the writer prefers rubbing down faulty teeth by hand, when one can get brains behind the carborundam slip. A man who knows his business has the sense not to interfere unduly with the pitch line; a gear grinder usually wipes it out. Moreover unless things are very bad a good man will correct a faulty gear, especially small gears, as quickly as the machine that requires setting will do it.

When the last word is said, the crux of the situation is in knowing exactly what is wrong.

Differential gears are in a class to themselves and are better and more economically treated before they are hardened.

Another and perhaps the chief cause of noisy gears, has not been mentioned, that cause being the ignorant foreman.

Bristol, England. John Haig.

Worm Gearing Troubles and the Remedy

Referring to the letter of J. Wilson in the matter of "Worm Gearing Troubles and the Remedy," the end thrust developed by any worm drive may be easily calculated from the formula

$$T = \frac{33{,}000 \times HP}{R \times P},$$

where

T = Thrust in pounds,
R = Rotations of worm per minute,
P = Pitch of worm in feet.

Taking the second case given by your correspondent, $T = 7071$ pounds.

The modification he suggests would no doubt improve the drive, but would not affect the end thrust unless the speed also were altered, but if the improvements suggested in your foot note were adopted the thrust would be reduced to 4714 pounds, which in itself is a material advantage, although even the larger load could quite satisfactorily be carried by a ball-thrust bearing which would almost entirely eliminate the friction at this point.

It will be observed that no allowance is made in the above formula for the friction between the worm and wheel. An additional factor based upon the coefficient of friction for the two metals, would need to be introduced if it were desirable to obtain the exact figure. This would, of course, reduce the thrust. It may be omitted, however, if only comparisons are required.

Harry Sibbering.

Birmingham, England.

Cutting a 77 Tooth Gear—Emergency Indexing

At page 473 there appears an article by Mr. McArdell in which is described a method of cutting a 77-tooth gear, the method being applicable to some other odd numbers also and avoiding the necessity of special plates. As this method does not apply to 125 I will endeavor to explain a method I once made use of to graduate a collar with that number of lines.

There being no plate available which would suit the job, I took one of the larger change gears, found in the cupboard of every universal miller, placed it on an arbor, between the centers, set the dividing head for 25 divisions and on the outer edge of the gear scratched off 25 lines with a surface gage, the needle, of course, being set about the hight of the centers.

Next I removed the gear from the arbor and placed it in position on the back of the head as if it were to be used for the "gear on worm" in spiral work.

I then clamped a piece of brass about one inch wide to the table so that it would bear against the edge of the gear and with the top end level with the center of the gear. The index plate was now unlocked from the head and one of the scratches previously made on the gear was brought around to the end of the brass strip and the first mark made on the work; eight divisions on the gear for each of the remaining 124 on the work completed the job. I used a pair of dividers and a piece of chalk to save the trouble of counting every move and by keeping the backlash all one way a very satisfactory job was the result.

Daniel F. Moriarty.

South Meriden, Conn.

In regard to that 77-tooth gear described at page 473, the writer did not state what kind of a machine it was cut on, but we are led to believe it was a universal miller. The table of compound-index movements in "Construction and Use of Milling Machines," published by Brown & Sharpe, will save much work in such cases. They give for 77 divisions, $\frac{9}{21} + \frac{8}{33}$, which is equal to $\frac{49}{77}$ since $\frac{9}{21} + \frac{8}{33} = \frac{3}{7} + \frac{8}{11} = \frac{33}{77} + \frac{7}{77} = \frac{49}{77}$. For spacing 99 divisions $\frac{4}{11} + \frac{6}{33}$ will do the trick.

Methods of differential indexing are also fully described in this treatise.

Boston, Mass. W. H. S.

The Santos Dumont No. 20—"La Demoiselle"

The Smallest of the Aeroplanes. Length 20 Feet, Width 20 Feet, Weight 242 Pounds, Supporting Surface 107 Square Feet, Horsepower 30

SPECIAL CORRESPONDENCE

The latest Santos Dumont creation, the No. 20, or, as more familiarly known, "La Demoiselle" (see Fig. 1), has the distinction of being the smallest of all the successful aëroplanes yet constructed. Besides being the smallest, it is the fastest machine, for it is estimated that it made as high as 96 kilometers an hour at its greatest speed in its cross-country flight from Saint Cyr to Rambouillet on September 18 last, and from Saint Cyr to Buc, a distance of 8 kilometers, which was covered in 5 minutes, or an average speed of 55.8 miles per hour.

M. Santos Dumont has made the unusual announcement that he gives freely to the public any of the rights which he might maintain in regard to his machine, and further states in a printed circular that although he hoped that anyone could obtain these machines by having them built themselves for a total cost of 6000 or 7000 francs, the cost of the engine would increase this amount somewhat. Arrangements have been made with Clement & Charron by which 1000 of these little voiturettes of the air will be turned out at a reasonable price in a very short time.

The Inventor and His Records

M. Santos Dumont has built 20 successful machines, each an improvement on the previous one. He has an enviable record of prizes won both with dirigible balloons and aëroplanes, and he was the first to fly in public with a heavier-than-air machine.

Alberto Santos Dumont was born in Sao Paolo, Brazil, July 20, 1873. He was the first to successfully use an explosion engine in a dirigible balloon and won, on October 19, 1901, the Deutsch de La Meurthe prize of 100,000 francs ($20,000) by sailing from the Aëro Club park to the Eiffel tower and returning in 30 minutes, the first voyage ever accomplished by a dirigible over a previously determined course at an announced time.

On July 4, 1906, he made the first public flight of a mechanically driven flying machine at Bagatelle. This machine is shown in Fig. 2.

He is a chevalier of the Legion of Honor, and has contributed as much as any man in France to the cause of aviation. Moreover, he has secured the honor of being able to rise in the shortest distance from the point of starting to the point of leaving the ground.

The *Official Record* of the Aëro Club of France states that the machine rose after traveling 70 kilometers in 6½ seconds, beating the record of Mr. Curtiss, whose machine at Brescia made a record of 80 kilometers, for getting into the air. The "Demoiselle" actually rose after going only 40 kilometers, but it touched the earth again and required 70 kilometers to get fully under way.

We are all familiar with the way in which M. Santos Dumont went in his small dirigible, or "runabout," as he called it, from his hangar to his Paris residence in the early morning, took his coffee while his airship was held outside and sailed back again safely.

On September 17 he started from Saint Cyr and flew to the house of a friend, landing in the park of the Countess de Galard near Davron, about 17 kilometers distant, which was covered in about 15 minutes. The Countess offered him hospitality, and the little "Demoiselle" was put away in one of the sheds. A severe thunderstorm came up suddenly and the watchers at Saint Cyr became anxious for his safety; they searched for some time before they finally found him calmly enjoying his supper.

The day before this episode, M. Santos Dumont made a flight from Saint Cyr to Buc and return and another flight in which he placed a weight of 40 pounds on one side of the frame of the machine and still

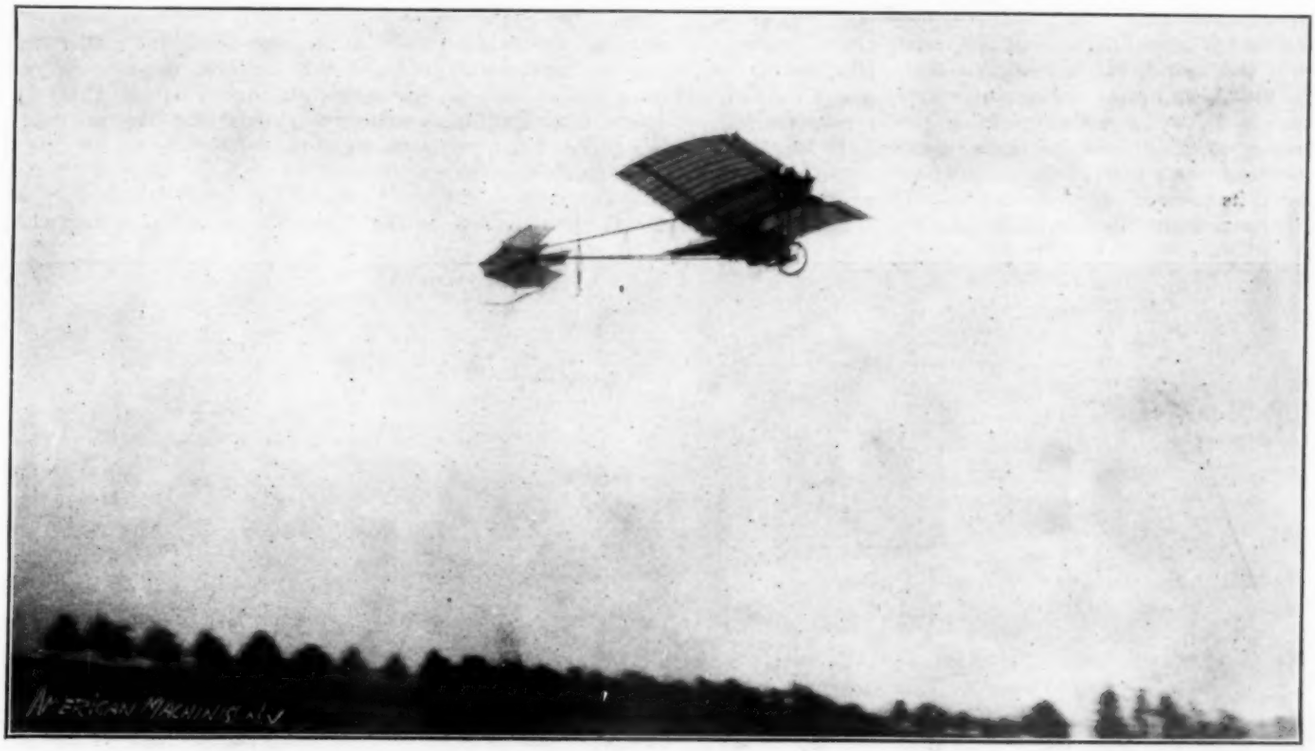


FIG. 1. SANTOS DUMONT'S "DEMOISELLE" IN FLIGHT

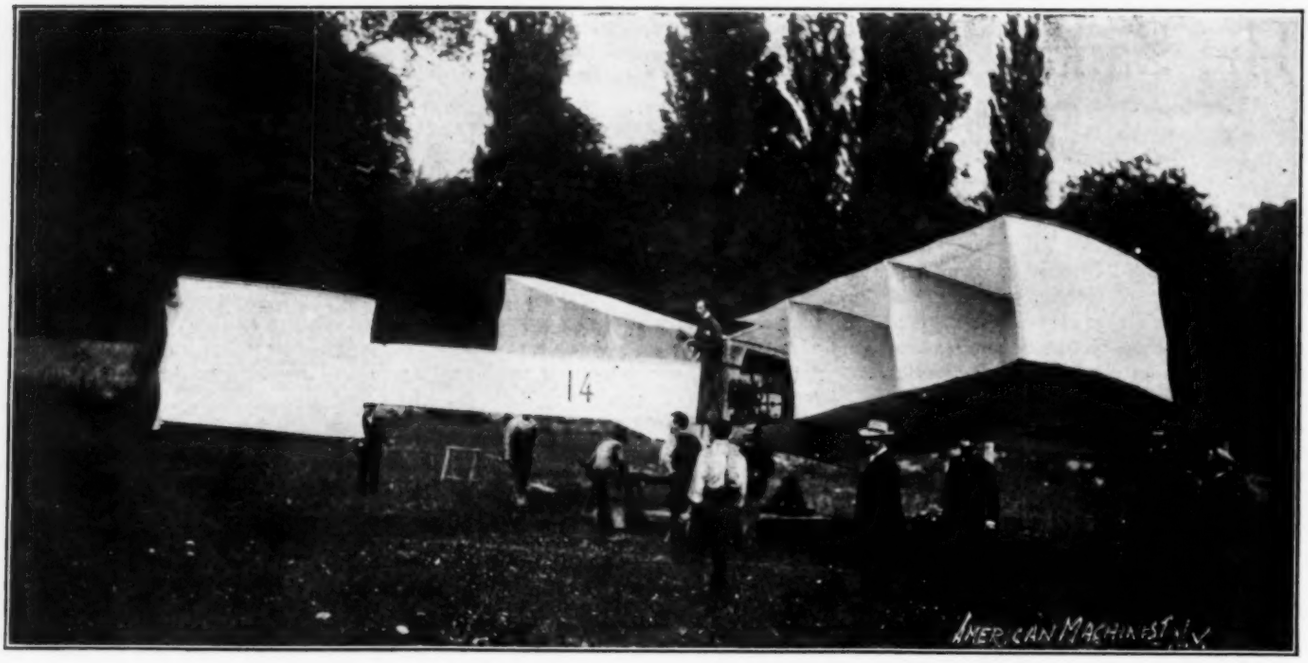


FIG. 2. THE AËROPLANE OF SANTOS DUMONT THAT MADE THE FIRST PUBLIC FLIGHT IN THE WORLD

was able to keep it on an even keel, even when the weight was suddenly released. He also demonstrated the stability of his machine by flying without holding the steering apparatus and waving a handkerchief in each hand while the machine flew of its own accord.

The monoplane "Demoiselle" weighs but 118 kilograms (242 pounds) without the pilot, and has only 10 square meters (107 square feet) of supporting surface. It is 6 meters (20 feet) wide and 6 meters (20 feet) long by 4 feet 2 inches in hight, or to the top of the propeller at its extreme position 7 feet 5 inches.

Bamboo is used for the chassis and frame of the main plane, and rudder and is ingeniously arranged to serve the requirements, although it is not always a satisfactory material for the important members of the framework.

The Chassis

The Chassis consists of a triangular

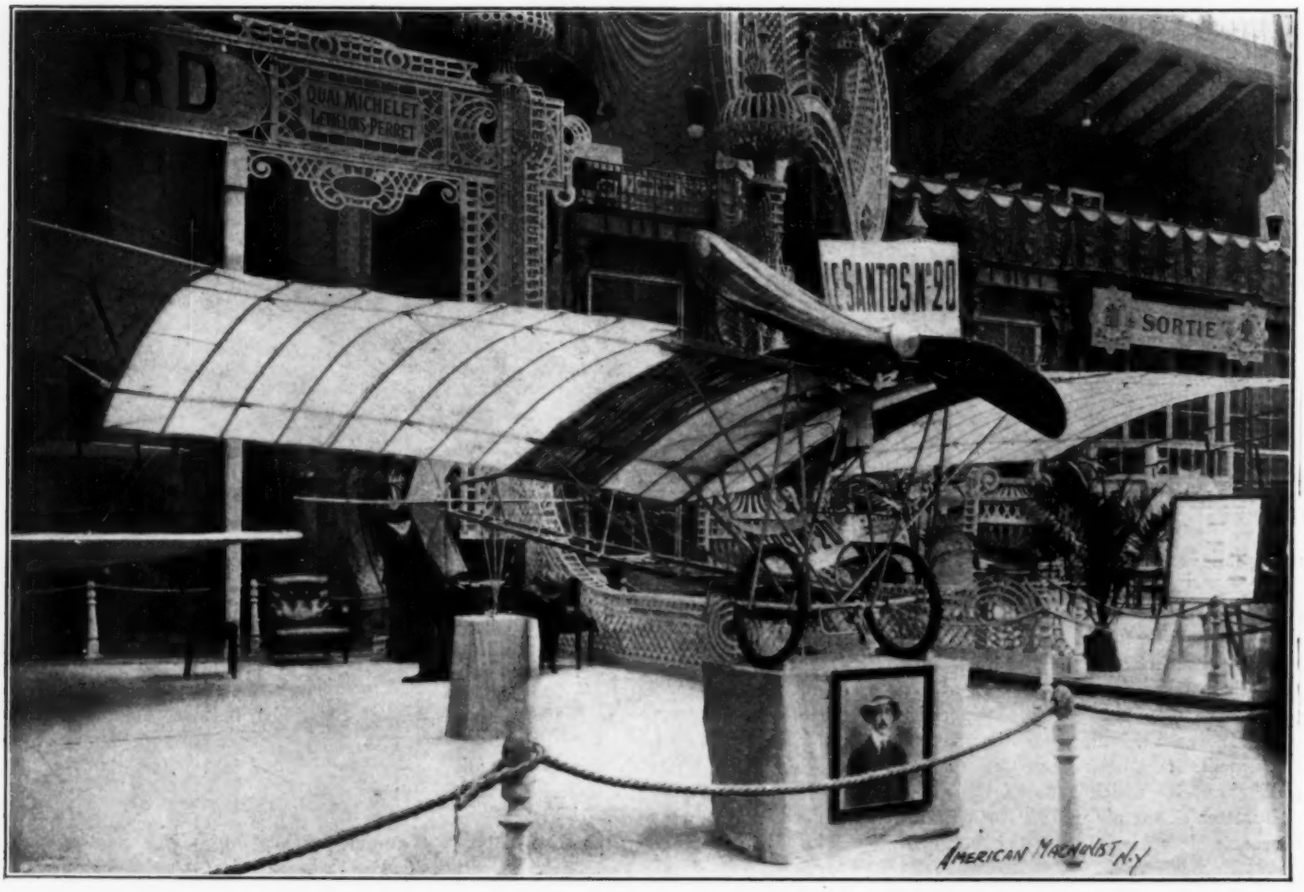


FIG. 3. SANTOS DUMONT'S "DEMOISELLE" AT THE PARIS EXPOSITION

frame with the three main members of stout bamboo about 2 inches in diameter, two below and one above coming to a point in the rear (refer to Fig. 3). These three members of a triangle are connected and braced together by steel struts of oval section. The length of the main frame is 16 feet 5 inches from the point of intersection at the rear where the tail is hung to the front. The main planes are attached to the upper point of the triangular front where the motor is also located; two small bicycle wheels 20 inches in diameter with pneumatic tires are attached to each lower corner of the front triangle having inclined axles so that the tops of the wheels are nearer together than the treads. These wheels support the machine when it runs on the ground in starting; the tail is supported by a vertical strut of steel tubing which is curved to form a runner at its lower extremity. This strut is also used to carry the wires which move the tail in the directions necessary to elevate and lower the machine. A runner is all that is required at this point, for as soon as the machine starts the tail is lifted free before the front wheels leave the ground.

A sling of leather and canvas which serves for a seat is provided for the pilot directly back on the front wheels with a footrest hung from the front axle. Here the aviator sits in a cramped position under the main wings. Fig. 4 illustrates this position, although the machine there shown is 19 Bis instead of the No. 20.

The knots on the bamboo are smoothed down and wrapped to prevent their splitting and to reduce resistance. The diagonal wires are provided with neat turn buckles less than an inch long, which enable them to be tightened when they become loose. At the rear edge of the main planes the three members of the frame can be taken apart for ease of transportation and brass sockets are arranged at these points so that they may be fitted together.

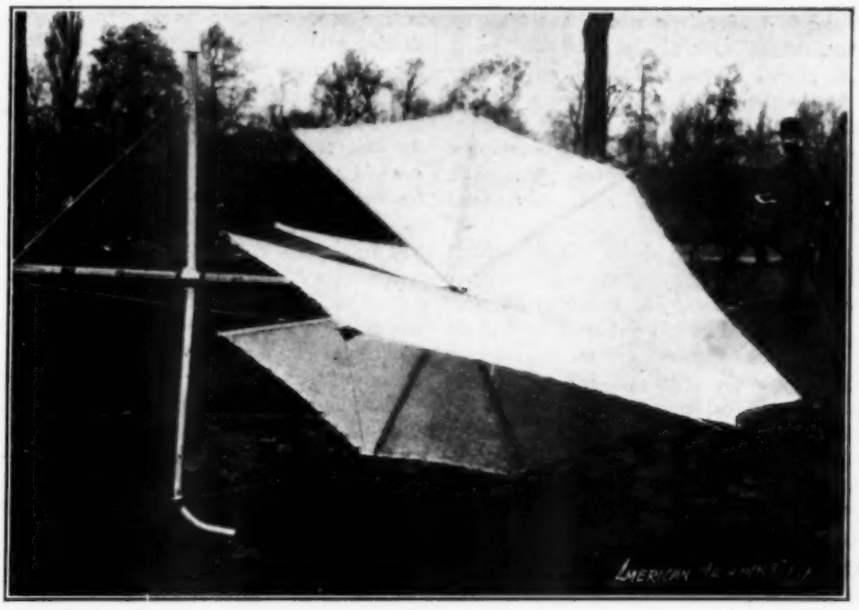


FIG. 5. TAIL OF SANTOS DUMONT'S AËROPLANE NO. 19

The Santos Dumont No. 19 Bis machine, built just previous to the "Demoiselle," had a single stout bamboo pole jointed which extended to the rear and carried the tail. Three wheels were provided forming a carriage under the central portion of this machine.

The Main Planes

The two halves of the main supporting surface are set at a slight dihedral angle to each other. This arrangement is a well known and characteristic feature of M. Santos Dumont's principle of construction, as he has used it on all of his previous machines (see Fig. 3).

Two transverse spars 18 feet long, the forward about 9 inches back of the front edge and the rear 1 foot from the rear edge of the surface form the longitudinal support of the wings. They are of ash and are made heaviest a few feet from the center of the dihedral angle, at which point they are 2 inches wide by 1⅛ inches deep, growing smaller until they are less than an inch in depth but full width where they are joined to the middle bamboo of the chassis. Underneath these transverse spars and attached to them are the small curved ribs with a chord length of 6 feet 5 inches. The whole is covered with silk, and all the diagonal wires used in bracing pass within the covering, giving a neat finish and a simple appearance. The corners are braced with light bamboo pieces which run from the main spars to the corners, doing away with the necessity for a heavy end rib. Wires extend along both front and rear edges of the planes through the extremity of each rib; a lacing passing over this wire at the rear edge draws the covering surface tight, stretching the material to a sharp edge; the covering material is also sewn together between each rib, strengthening the wing and forming a series of pockets.

The angle of incidence of the main plane is greatest in the center and slightly less at the extremities of the wing, while the greatest depth to the aëro curve or its camber—about 4 inches—is just forward of a transverse line through the center of the planes and not as near the forward edge as in general practice; the total surface is about 107 square feet. This is almost half the size of that of Bleriot's smallest monoplane, and not a fifth of that of the Wright machine.

The Tail

The tail of the "Demoiselle" is quite different from that of any of the machines yet built by other inventors, although it

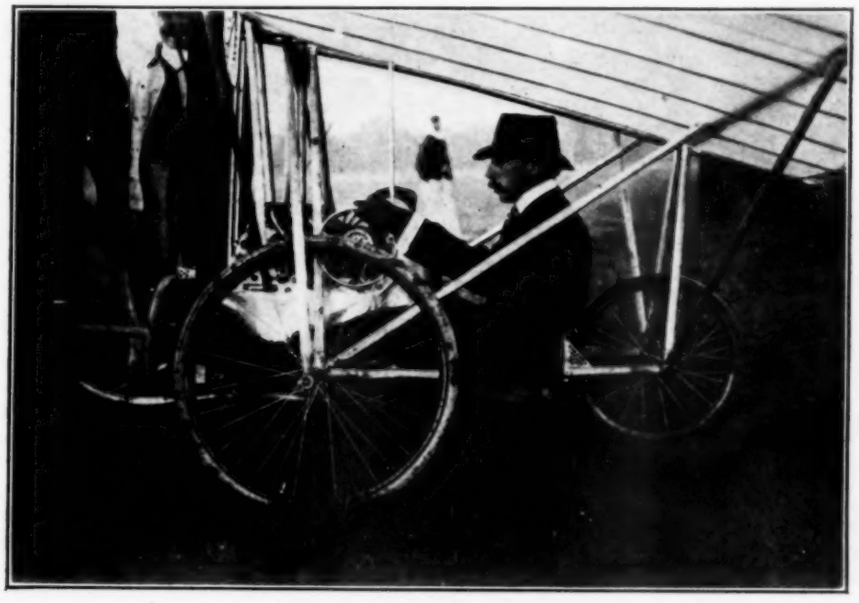


FIG. 4. SEAT AND STEERING WHEELS OF SANTOS DUMONT AËROPLANE NO. 19

follows directly the original idea embodied in the first aëroplane which was built by M. Santos Dumont. In this machine it was placed in the front and was simply a box without ends mounted on a universal joint in such a manner that it could be pointed in any direction by combining movements, about its central point as a pivot, in both a vertical and a horizontal plane.

The final form which this important member has taken is that of intersecting kite-shaped planes, Fig. 5, one in the vertical plane and one in the horizontal plane made of light bamboo sticks crossed; each plane has a V-shaped section cut out of its forward side which allows it to be moved as a whole without its surfaces interfering with the main frame to which it is attached, about 10 feet back of the main wings, by a very ingenious universal joint. The horizontal surfaces of the tail are 6 feet 5 inches wide by 4 feet 9 inches from front to rear; the vertical surface is the same general shape, but is only 3 feet 7 inches high by 4 feet 9 inches long.

Methods of Control

The control of this machine is accomplished by three principal movements for rising, steering and balancing; at the right hand of the operator is the elevating and depressing lever connected by wires to the tail in the rear. One of these wires passes through a guide or ring at the top of the vertical strut just in front of the tail and the other passes through a ring at the bottom. Pulling on these wires inclines the tail in such a way that the horizontal portion of its surface acts for elevating and depressing. The vertical surface of the rudder, which steers the aëroplane to the right or left in a horizontal plane, is moved by wires which run to a small vertical handwheel turned by the left hand of the pilot.

Balancing is done by warping the wings in the same manner as in the Wright, Bleriot and Antoinette machines. Steel wires run from the outer rear corners of the main surfaces to a vertical lever pivoted immediately behind the back of the aviator, who has a small copper tube sewn into the back of his coat which fits over the top of this lever; by leaning to one side or the other when the machine tips the wings are warped and cause the machine to regain its equilibrium. It may be noticed that there is no connection between the control of the wings and the movements of the tail except through the operator; the movements for balancing are natural and similar to those which a cyclist unconsciously performs when he leans his body to one side or the other in order to manage the balance of his machine. This machine is very perfectly balanced, as was clearly demonstrated when M. Santos Dumont flew at 40 miles an hour without touching the controlling lever or the steering wheel. No automobile would permit of its driver doing this. Like an up-to-date automobile the "Demoiselle" is provided with a foot-actuated accelerating lever or throttle controlled by a sort of stirrup for the left foot. A switch button is fixed to the elevating lever which governs the ignition and stops the motor, and the operator is in such a position that he can use his hands on the tires as brakes to stop the machine when descent is accomplished. Springs are introduced in the controlling wires for each of the steering systems so as to take up the slack under all conditions.

The Engine and Propeller

The motor of the "Demoiselle" is a new design, made especially by Messrs. Darracq, of Puteaux, near Paris (see Figs. 6 and 7). A lawsuit has arisen as to the patent rights which are claimed by the Darracq firm. Santos Dumont claims that the motor was made to his order, and as he has paid for it that he can assign the right to manufacture it to any firm he pleases. The motor is a twin-cylinder horizontal type with opposed cylinders. The bore and stroke are 130 and 120 millimeters, respectively (5.2 and 4.8 inches), giving 30 horsepower with a total weight of 45 kilograms, or 110 pounds. This motor is perfectly balanced, and the relations between the two cylinders are as follows, referring to Fig. 8:

First Cylinder	Second Cylinder.
Suction	Explosion
Compression	Exhaust
Explosion	Suction
Exhaust	Compression

The pistons are at all times at equal speeds and opposed in direction of motion. This mutually neutralizes the inertia forces due to acceleration. The forces due to oblique movements of the connecting rods are so small in comparison to the first that they may be neglected in so small a motor. The valves are situated at the ends of the cylinders and are actuated by tappets. Auxiliary exhaust ports are drilled through the cylinder walls increasing the power of the engine. The cooling water is circulated by a gear pump and from the water reservoir passes through jackets around the cylinders to a very ingeniously constructed radiator. This consists of two sets of copper tubes, 100 in each group, which are attached one on each side of the center of the machine to the under side of the wing, thus offering practically no resistance to flight. The total cooling surface is 3.2 square meters (34 square feet); while flying these tubes are swept by a current of air at more than 200 feet per second; there is, therefore, little danger of the motor overheating in spite of the small reservoir capacity for water. The ignition is by a special high-tension magneto permitting of starting

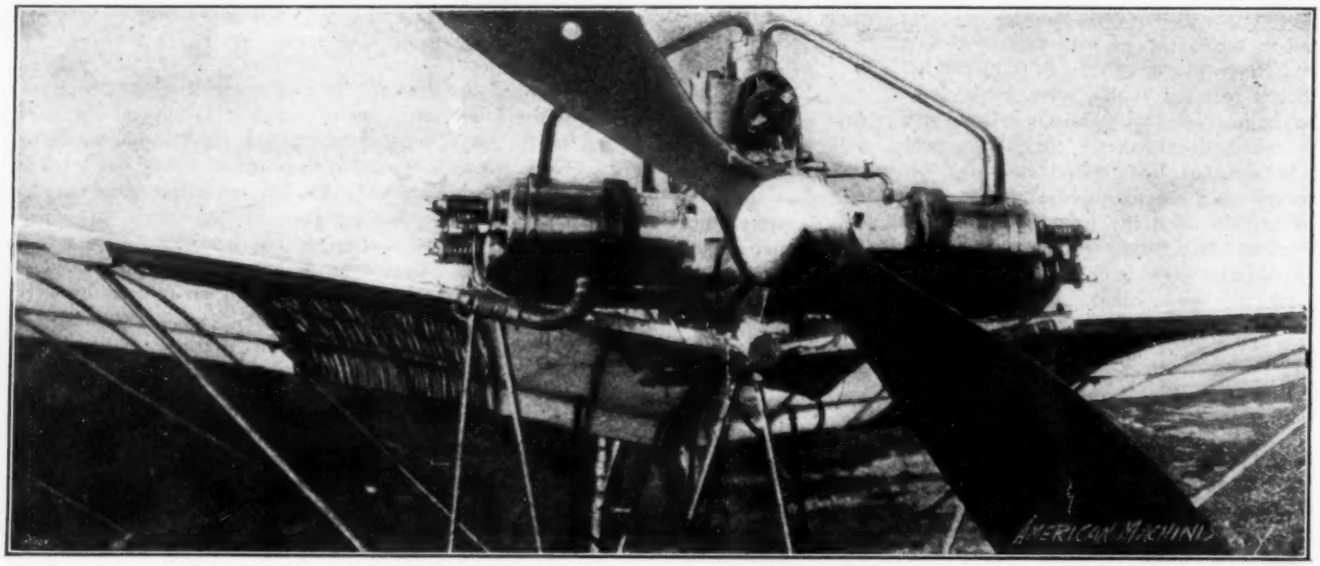


FIG. 6. VIEW OF SANTOS DUMONT'S MOTOR OF THE "DEMOISELLE"

without coils or battery. The main petrol tank is placed behind the pilot and a pipe from this tank goes to a small auxiliary spindle-shaped tank just above the carbureter; air pressure forces the petrol into this auxiliary tank where it flows by gravity to the carbureter. An air pump is operated by the motor to keep up the air pressure and a rubber bulb gives the necessary initial pressure for the starting (see Fig. 9). The water reservoir is placed over the motor in a forward compartment of the auxiliary petrol tank.

The propeller is of the type Chauviere Integrale, and turns normally at 1500 revolutions per minute. It is fastened directly to the crank shaft of the motor and no flywheel is necessary. Mr. Chauviere says that this propeller, which is made in one piece, is designed for a speed of 2000 revolutions per minute if necessary.

The engine is mounted on the upper bamboo piece of the main frame and supports for it are provided between the cylinder heads and the front traverse spars of the main planes. It is carried bodily a slight distance above these planes and the blades of the propeller cut across the line of sight of the operator. The front edge of the main planes are cut away to allow the propeller free action.

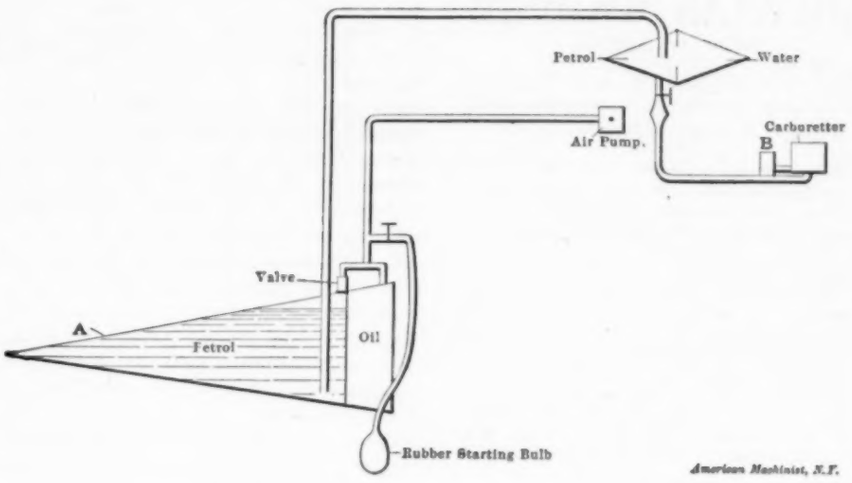


FIG. 9. ARRANGEMENT OF PETROL AND OIL TANKS AND PIPING

PORTABLENESS AN IMPORTANT FEATURE OF THE "DEMOISELLE"

This machine is made to fold up so it can be transported on any ordinary automobile. The main frame is taken apart at its joints and packed under the wings, while the whole machine is placed on a platform especially constructed on the rear of an automobile.

There is little doubt that aërial navigation of the future will be largely by some such small, light, and relatively cheap aëroplanes. The reduction of supporting surface requires a great increase in speed. We may, therefore, await in all confidence the advent of small planes for one person traveling at from 125 to 150 kilometers

FIG. 8. ARRANGEMENT OF CYLINDERS OF SANTOS DUMONT AËROPLANE MOTOR

(77 to 93 miles) an hour. Mr. Wright has made the statement that "based on our present experience it seems perfectly possible to build an aëroplane to go 1000 miles at a speed of 100 miles per hour and carrying six people." Such a machine would certainly be the antitype of the "Demoiselle."

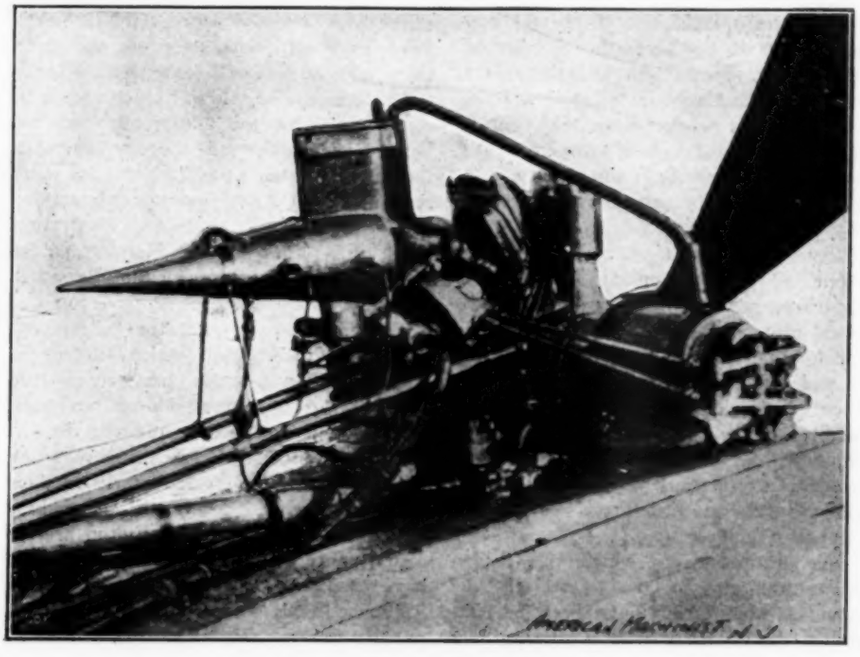


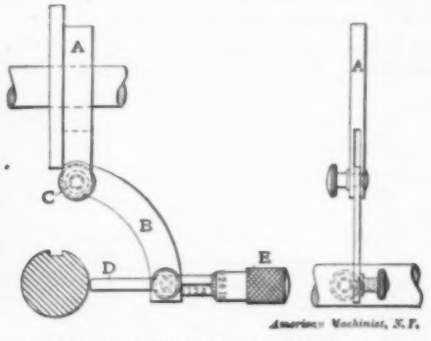
FIG. 7. REAR VIEW OF SANTOS DUMONT MOTOR

A Gage for Centering Work with the Milling Cutter

By H. D. CHAPMAN

Practical mechanics will appreciate the utility and convenience of the tool herewith described.

The sketch shows a gage for setting milling cutters central with the work. The gage is made of an old micrometer-barrel and the construction of the frame is shown clearly in the drawing, as is also the way in which it is used. Place the



GAGE FOR SETTING WORK CENTRAL WITH MILLING CUTTER

base *A* against the cutter and move arm *B*, which swivels at pivot *C*, so that the point of the micrometer spindle *D* nearly touches the job, then adjust the micrometer by the thimble *E* and note the reading of the graduations. Then use the tool on the other side of the cutters in the same way, adjusting the work until the measurement shows the same on each side. I have also found this tool very handy for setting work on the grinder and the planer where it is important that accurate results should be obtained.

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Fulton and Steam Navigation

Now that the noise of the Hudson-Fulton celebration has died away, during which the work of Robert Fulton has been discussed almost without limit, with conclusions that have varied between the extremes of laudation on the one hand and of detraction on the other, it is perhaps well to sum up the case as we see it.

It is, of course, well known that others, both in this country and abroad, made steamboats which actually ran prior to the "Clermont," and the detractors of Fulton have paraded these facts as conclusive evidence that Fulton was not the inventor of the steamboat.

The well informed have never claimed this honor for Fulton, whose achievement is set down as having been the inauguration of steam navigation in the sense that he built the first steamboat which was a commercial success, and from which the real progress of steam navigation may be traced.

There is almost no great invention which can be attributed to a single inventor. The case of Fulton and the steamboat is almost exactly parallel with that of Stephenson and the locomotive. Locomotives had been built for 25 years prior to the appearance of Stephenson's "Rocket," some of which were more successful than any of the steamboats which preceded the "Clermont." There is scarcely a single element of the locomotive as it is made today that can be attributed to Stephenson, the most important of all the early locomotives in this sense being the "Puffing Billy" of Hedley, but even this requires the closest analysis to detect in its structure any of the elements which are now considered fundamental.

The "Rocket" was nothing more than a successful assembly of elements which had been originated by others and precisely the same is true of the "Clermont." Nevertheless, Stephenson was, for years, looked upon in England almost as a demigod, whereas it is precisely in that country that the claims of Fulton are persistently passed over as of slight importance.

Very similar situations exist before our eyes today in at least two important fields of development, namely, the automobile and the aëroplane. It is true that there has been no spectacular individual piece of success in the automobile field to compare with Stephenson's "Rocket" and Fulton's "Clermont," although the recent court decision, sustaining the validity of the Selden patent creates a situation that, apart from the awarding of the laurel wreath in the minds of the public, differs but little from the cases of Stephenson and Fulton.

The arguments by which the Selden patent was attacked were precisely the same as those which have been brought against the claims of Fulton, namely, that he invented nothing not already known. He did, however, assemble these well known elements in a manner which was novel and which accomplished the purpose, the combination forming the essentials of the mechanism of all present-day gasolene-engine automobiles.

The parallel is less perfect in the field of the aëroplane because the Wright brothers were undoubtedly the first to make actual flights with a power-driven man-carrying aëroplane. Even in their case, however, we have the preliminary work of Langley and others which did much to pave the way and demonstrate the feasibility of mechanical flight.

In this connection it is important to point out that Fulton himself claimed even less for himself than the merit for making a new combination of elements. Not only was he well aware of the work of others, but he acknowledged it in the most official form possible, namely, in his original patent, in which he claims to be "The first who had laid down rules that will secure success in building such boats or vessels; no patent or publications having hitherto appeared in which exact mathematical principles are explained to guide artisans to success in works of this kind. . . . . The development of these principles is indispensable to the most perfect construction of steamboats; it is owing to a want of accurate knowledge of these principles that the essays on steamboats which have been made in different countries for 30 years have hitherto failed."

Here certainly is frankness itself. These claims are those of an engineer rather than of an inventor, and indeed it is difficult to see how, had the close scrutiny of patent applications which now prevail, been in practice in Fulton's day he could have been awarded any patent at all. He was, in fact, granted a monopoly rather than a patent in the modern sense.

This does not, in our judgment, detract in the least from the merit of his achievement, especially since precisely the same thing may be said of Stephenson's "Rocket." More may be said of Selden's work in connection with the automobile and the Wright brothers' work in connection with the aëroplane, but as against this we must remember that many important inventions are not patentable, a classic illustration being the refusal of the German patent office to issue a patent for the Bessemer process.

The fact remains that the "Clermont" is the landmark from which success in steam navigation dates, precisely as the "Rocket" is the corresponding landmark of locomotive progress, and the Selden automobile and the Wright brothers' flying machine corresponding landmarks in their respective fields. Many of the claims which have been made for Fulton are, of course, absurd, but equally absurd claims have been made for Stephenson. In our judgment, both did enough to justify the position where history has placed them; and while neither did as much as their

over-zealous admirers have claimed, as for that matter, few popular heros have done, each one did enough to place his accepted historical position upon a secure foundation.

Rhode Island Branch of the National Metal Trade Association

The Rhode Island branch of the National Metal Trade Association held a very interesting meeting on the evening of October 21. The topic under discussion was Industrial Education, the opening address being made by Principal Weston of the Technical High School of Providence. He was followed by C. E. Hildreth, of the Whitcomb-Blaisdell Company, Worcester, Mass., urging that the association set themselves the task of helping to solve this very important question. Henry D. Sharpe spoke from his own experience along this line and urged that a personal interest be given to the apprentice in addition to the actual learning of the trade itself.

Charles Fosdick, of Fitchburg, gave an outline of the working of the coöperative plan in that city by which high-school boys, who desired to become mechanics, alternate weekly between the high school and the shop. The plan is now in its second year in Fitchburg and appears to be giving entire satisfaction both to the manufacturers and to the boys themselves. He urged that other cities give this plan careful consideration as he believed it presented a solution which would prove helpful in most cases.

New Publications

TABLES AND OTHER DATA FOR ENGINEERS AND BUSINESS MEN. By Chas. E. Ferris. Thirteenth edition; 165 2½x5½-inch pages; indexed. University Press, Knoxville, Tenn. Price, 50 cents.

This is an enlarged and revised edition of this valuable little vest-pocket handbook, preceding issues of which we have received from time to time. The more commonly needed engineering tables are given in a usable form, together with other useful data. Its size is very much in its favor as it fits readily into a vest-pocket.

ELEMENTS OF MACHINE DESIGN. By Kimball and Barr. 444 5¾x9-inch pages; 196 illustrations; indexed. John Wiley & Sons, New York City. Price, $3, net.

Occasionally a book reaches the hands of the reviewer, a consideration of which is nothing short of a real pleasure. Such a book must, of course, conform very closely in scope and treatment to the reviewer's ideals for the subject treated, and such is the situation after a reading of this new book by Professors Kimball and Barr. While intended primarily as a textbook for engineering students, it will also prove of value and assistance to machine designers and draftsmen, and to such we most heartily recommend it. A strong feature is the absence of undigested treatments of details of construction that are at once branded by the experienced machine designer as theoretical and scholastic; or, stated somewhat differently, the text shows that the authors are intimately acquainted with machine designing and machine-shop practice. The work naturally divides itself into two sections, the first comprising Chapters 1 to 4, inclusive, treating of fundamental principles of machine design, energy and force problems, straining action in machine elements, and friction, lubrication and efficiency. The second part, Chapters 5 to 16, inclusive, discusses the more important machine details with a view of showing how the theoretical considerations and equations stated in the first part are applied and modified in practice. In this second section are numerous references to well known manufactured machine parts. For illustration, in connection with ball and roller bearings, the Hyatt roller bearings are mentioned by name, constructions are shown which exemplify the Chapman and Hess-Bright ball-bearing principles, and yet another illustration shows the type of heavy thrust roller bearings made by the Standard Company. Frequent references are made to the *Transactions* of the American Society of Mechanical Engineers, and the work of well known investigators. Page 185 shows a chart plotted from equations expressing the relations between efficiency and pitch angle of screws. Excepting the work of Mr. Halsey in regard to the efficiency of worms published several years ago in the AMERICAN MACHINIST and later in book form, we believe this is the first carefully analyzed and usable published discussion of this subject. *Apropos* of the perennial controversy over the English and American designs for lathe bed ways we quote: "But, as a rule, the bearing surfaces of such V-guides are very small, and wear soon begins to be apparent, especially as the wear of the carriage is usually concentrated on a short portion of the bed. There is a tendency among manufacturers to discard the V-guide in favor of the flat surface. English practice, especially on large tools, is in advance of American practice in this particular. A combination of V and flat guides is also often used."

The chapter headings are as follows: Chapter 1, Introductory, Definitions and Fundamental Principles of Machine Design; Chapter 2, The Energy and Force Problem, Consideration of Machines as a Means of Modifying Energy; Chapter 3, Straining Action In Machine Elements, Fundamental Formulas for Strength and Stiffness; Chapter 4, Friction, Lubrication and Efficiency; Chapter 5, Springs; Chapter 6, Riveted Fastenings; Chapter 7, Screws and Screw Fastenings; Chapter 8, Keys, Cotters and Force Fits; Chapter 9, Tubes, Pipes, Flues and Thin Plates; Chapter 10, Constraining Surfaces, Sliding Surfaces, Journals, Bearings, Roller and Ball Bearings; Chapter 11, Axles, Shafting and Coupling; Chapter 12, Belt, Rope and Chain Transmission; Chapter 13, Application of Friction, Friction Wheels, Friction Brakes and Clutches; Chapter 14, Toothed Gearing, Spur, Bevel and Screw Gears; Chapter 15, Flywheels, Pulleys and Rotating Disks; Chapter 16, Machine Frames and Attachments.

Personals*

Frank Keasby is requested to get in communication with the Mashek Engineering Company, New York City.

E. R. Stevenson, tool manager for the Norwalk Iron Works Company, South Norwalk, Conn., is temporarily engaged in Burgettstown, Penn.

A. D. Frost, formerly with the Harry S. Houpt Company, has been appointed sales manager of the Herreshoff Motor Company, Detroit, Mich.

E. E. Alexander, who has been shop engineer of the Cooke & Rogers Works of the American Locomotive Company, is now acting as chief draftsman of that plant.

Guy H. Gibbs, for the past eight years with the Westinghouse Electric and Manufacturing Company, is at present with the Western Electric Company, with headquarters in Cincinnati, Ohio.

Charles Napier, manager of the Quality Saw and Tool Works, Inc., Springfield, Mass., sailed for England on October 27. Mr. Napier will tour Europe in the interest of their foreign business.

Walter G. Holmes has been appointed chief draftsman of the Linderman Machine Company, Muskegon, Mich. Mr. Holmes was formerly connected with the American Sterilizer Company, Erie, Penn.

J. G. O. Sewell, until recently with the Tennessee Coal, Iron and Railroad Company, has become associated with the United Engineering and Foundry Company, Pittsburg, Penn., and will be in charge of estimating.

H. Terhune, for a number of years with the Billings & Spencer Company, and an occasional contributor to our columns, has resigned to accept a position with the E. W. Bliss Company, Brooklyn, N. Y., where he will be in charge of designing drop-forge machinery.

*Items for this column are solicited.

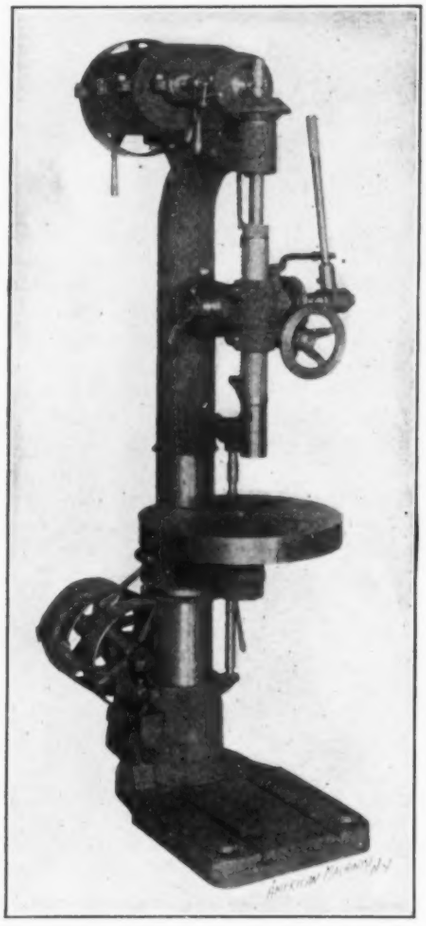
New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make it Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

New High Speed Drill

This new high-speed drill brought out by the Sibley Machine Tool Company, South Bend, Ind., was designed especially to meet the requirements of the automobile trade. The most prominent of its new features is the change-speed box located on the top of the column, entirely eliminating the cone pulleys and permitting eight changes of speed. These are so arranged that they may be instantly changed without shifting of bolts. It has ample power to run high-speed drills up to 1½ inches in diameter to the limit of their capacity. The gears run in oil and all bearings are bronze.



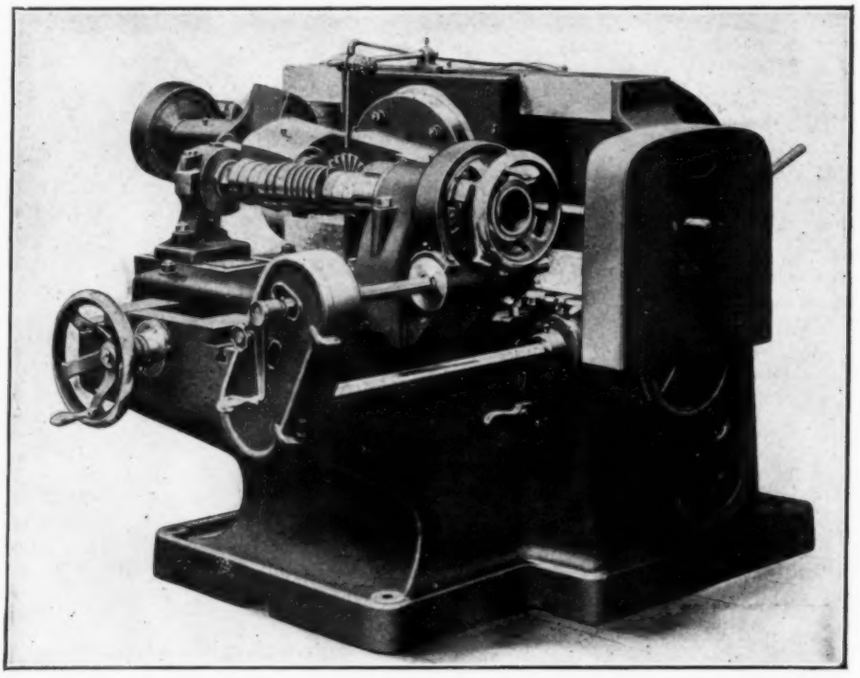
HIGH-SPEED DRILL

The large spindle is fitted for No. 4 Morse taper and has ball-thrust end bearings.

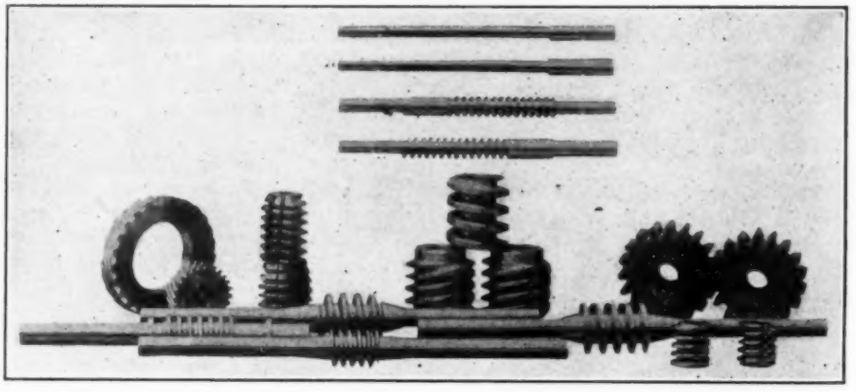
Worm and Gear Cutting Machine

This is a very substantial worm-milling machine which is just being put on the market by Alfred H. Schütte, 90 West street, New York City. It has been built especially for heavy work with a view of obtaining extreme rigidity in every part. The milling cutter is mounted on the spindle of the cross slide, the upper part of the cutter showing behind the worm to be cut, and can be adjusted to any desired angle according to the lead of the worm. The work is revolved by the worm shown at the right under the handwheel and the whole cutter head is fed along the substantial ways shown at the back.

In order to secure easy, accurate and substantial indexing for multiple-thread work, a ring is provided outside of the worm gear containing twelve wedge-shaped notches and a dog having a corresponding shape. This dog is connected to the spindle carrying the work and in cutting multiple threads the work spindle is adjusted to locate the new thread by releasing the handwheel nut and turning this dog into its correct position for the



WORM-MILLING MACHINE



SAMPLES OF WORK FROM WORM-MILLING MACHINE

next cut. This insures accurate indexing and avoids any slipping under the strain of a milling cutter at high speed and with heavy feed.

This machine can be used to cut spur or spiral gears of any size within its capacity, the work shown in Fig. 2 giving some idea of the variety of pieces which may be made with it. It can handle either worms or gears up to 14 inches in diameter and 8 inches long. It enables the use of a large milling cutter even on the smallest work, the usual cutter diameter being 7 inches. The smallest lead is ¼ inch to the revolution and the largest 60 inches per turn of the work. The minimum speed is ¼ inch per minute and the maximum 3½ inches per minute. The spindle has a 3½-inch hole and the entire machine weighs 6200 pounds.

For gear cutting there is a very complete indexing device inclosed in the oblong box surrounding the driving worm shaft and behind the crank handle shown on the end of it. This provides for any division that may be desired and makes a very complete machine for shops using a large number of worms and also wishing to cut gears of various kinds from time to time.

The Duplex Keyseating Machine

A general view of the Duplex keyseating machine brought out by the Chicago Machine Tool Company, of Chicago, Ill., is shown in Fig. 1. It is built on the lines of a milling machine, and has both horizontal and vertical spindles. The horizontal spindle is fitted with a taper arbor having a No. 9 Brown & Sharpe shank, held in place by a draw bar. This arbor carries a cutter for the desired width of keyseat, while in the vertical spindle is an end mill of the correct size, held in place by a draw-in collet.

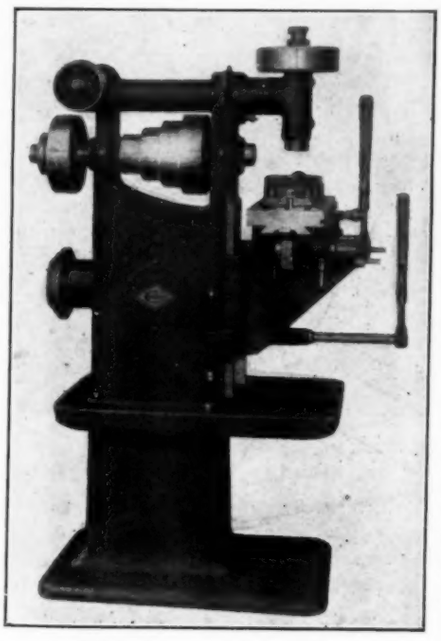


FIG. 1. KEYSEATING MACHINE

Fig. 2 shows the first part of its operation, the milling cutter having milled out

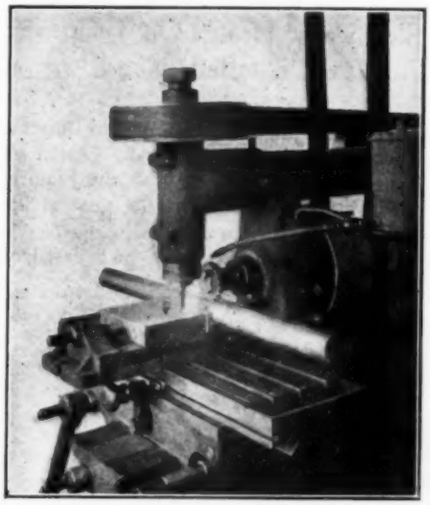


FIG. 2. MILLING THE KEYWAY

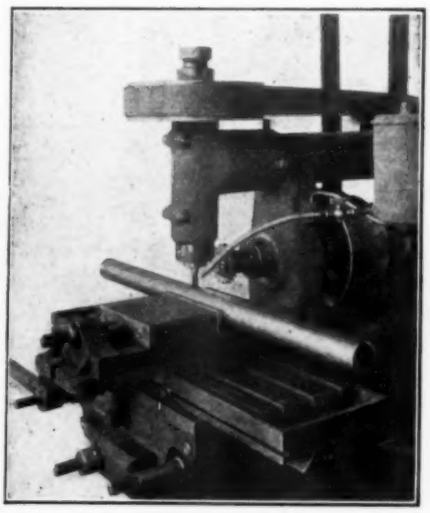


FIG. 3. ROUNDING OUT THE ENDS

the keyseat, all except squaring up the ends. In Fig. 3 the table carrying the vise and shaft has been brought out directly under the end mill by means of the hand-crank traverse feed. This brings the end mill into play for squaring up the ends of the feather keyseat and finishing the operation.

The machine is fully equipped with six changes of power feed as well as the crank and lever feeds, giving a sufficient range to cover all work, the lever doing good service in making a quick return on the table after a cut has been taken. An adjustable automatic stop to the table feed is also provided which may be set for the length of keyseat desired. The machine is built in three sizes and two styles.

Timing Device for Speed Indicator

The engravings illustrate a self-timing attachment applied to a speed indicator. The device is patented by Karl Weiss, 30 Woodlawn Terrace, Waterbury, Conn. It is shown as applied to a Starrett speed indicator. The indicator case shown is cut in two and the two parts connected with a hinge or knuckle joint so the worm gear can swing away from the worm on the spindle and thus stop registering the revolutions. A coiled spring swings the case from the center beam, when the retaining latch is thrown off by the extension of a disk fastened on the arbor of the main wheel in the movement. Power is furnished by the main spring fastened to the arbor of the main wheel. A disk with notches to engage a pawl holds the spring. The transmission from main wheel to escapement consists of a train of three wheels and pinions. The escapement is a gear with ratchet-shaped teeth which works in connection with a pallet from which extends a small wire acting as a governor. A small pin stops the disk from going all the way around. When the spring is run down to zero it is wound up by the nurled knob, each line representing 15 seconds. An eccentric screw acts as a regulator, this touching the wire of the governor.

In operation the case is pushed down and closed to connect the worm wheel with the running spindle. At the same time a pin releases a friction allowing the

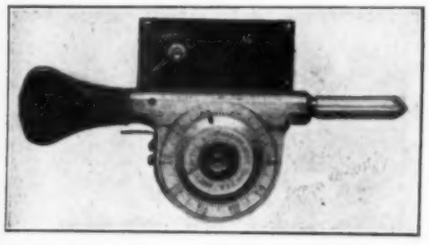


FIG. 1. TIMING DEVICE ON SPEED INDICATOR

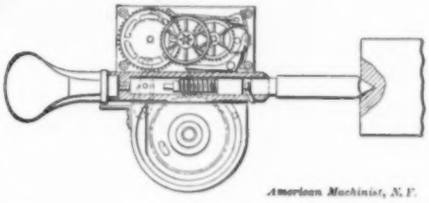


FIG. 2. TIMING DEVICE ON SPEED INDICATOR

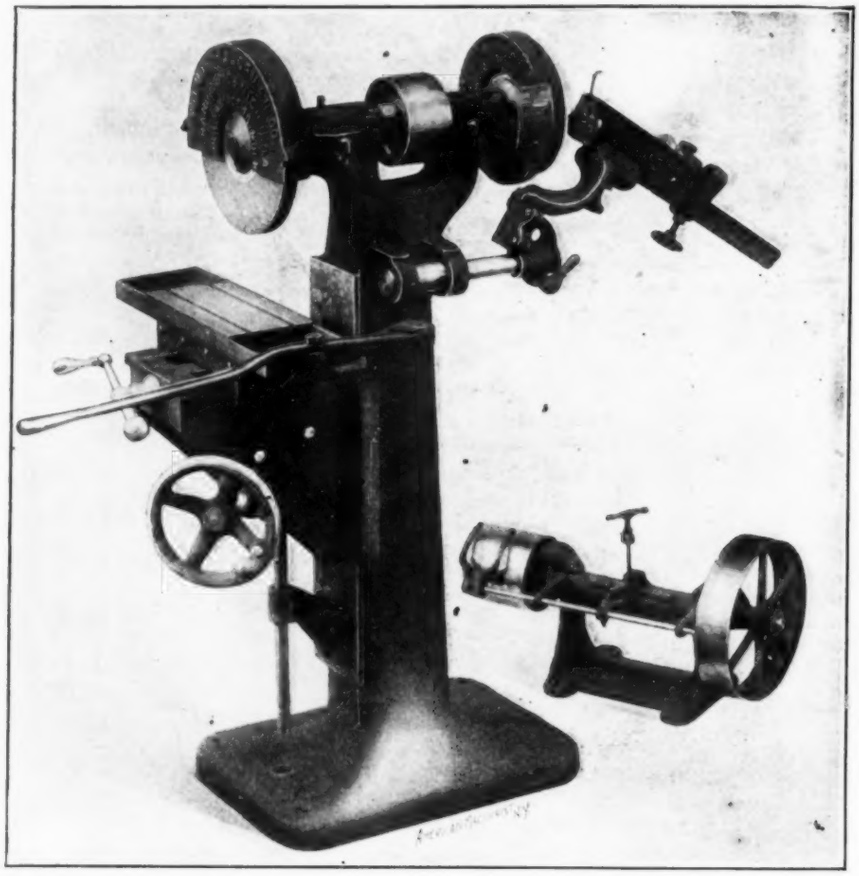
movement to start. A latch pressed in place by a spring holds the case closed until thrown open when the timing hand is run down to zero. When the spring is first put in it is wound up three turns so as to keep proper tension on the movement. The arbors of the wheels run in plates one of which may be solid with the beam in which the spindle runs. A frame around it takes the place of the pillars, if desired, also a second cover or crystal to keep it dust-proof. The movement will

run three minutes but only one minute run is usually required. When made for timing a single minute the hair spring is omitted, simplifying the construction. The device may, of course, be used in connection with various makes of speed indicators.

Surface Grinder with Twist Drill Attachment

This machine has been designed primarily as a surface grinder and has a working surface to the grinding table of 6x12 inches which covers most of the work which requires grinding in the average small shop. Sufficient movement is provided in both directions so that the wheel fully clears the table each way. Both the vertical movement of the knee and the cross movement of the table can be set to thousandths by graduated collars. The longitudinal movement of the table is controlled by the lever which is believed to be quicker and more convenient for work of this size than a screw. It is regularly equipped with a grinding wheel 12 inches in diameter and 1 inch thick running at a speed of 1400 revolutions per minute.,

The drill-grinding attachment is optional with the purchaser, being readily attached by means of the bar shown and only requires the use of a cup wheel at the other end of the grinding spindle. The grinding attachment needs no description as it is well known to users of drills. This machine is known as the No. 1 surface grinder and is made by the Wilmarth & Morman Company, Grand Rapids, Mich.



SURFACE AND DRILL GRINDER

Electrically Heated Oil Tempering Bath

The General Electric Company has recently perfected an electrically heated oil bath which seems to meet all the requirements of such apparatus, the general appearance being shown herewith.

The bath proper consists of a cast-iron tank, or pot, having 12 lugs evenly spaced around the sides. These lugs are drilled to receive standard cartridge units, and it is found by thus distributing the units that an even temperature can be maintained in all parts of the oil. Around the pot is placed a heat-retaining jacket consisting of an inner and outer wall of sheet metal, the space of 3 inches between the walls being filled with mineral wool. The jacketing on each side of the pot is easily removable, thus allowing quick access to the internal connections of the units. Around the top of the pot there is a wide flange to which are secured four cast-iron legs. A drain pipe controlled by a globe valve provides a means for drawing off the oil. There is a protected recess in one end of the pot, in which a thermometer can be placed to indicate the temperature of the oil.

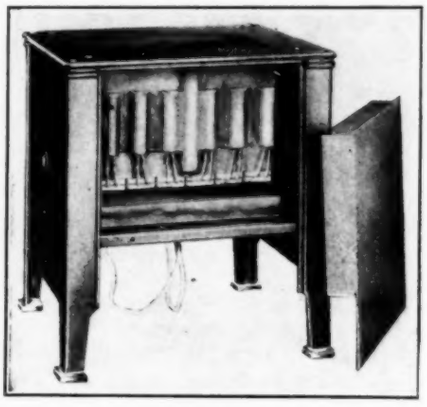


FIG. 1. ELECTRICALLY HEATED OIL TEMPERING BATH

There are two methods of using the oil bath. In the first method, the temperature of the oil is raised to about 250 degrees Fahrenheit, the work placed in the bath and full heat turned on. When the oil reaches the desired temperature the work is removed and the current turned off. This method requires a single-heat

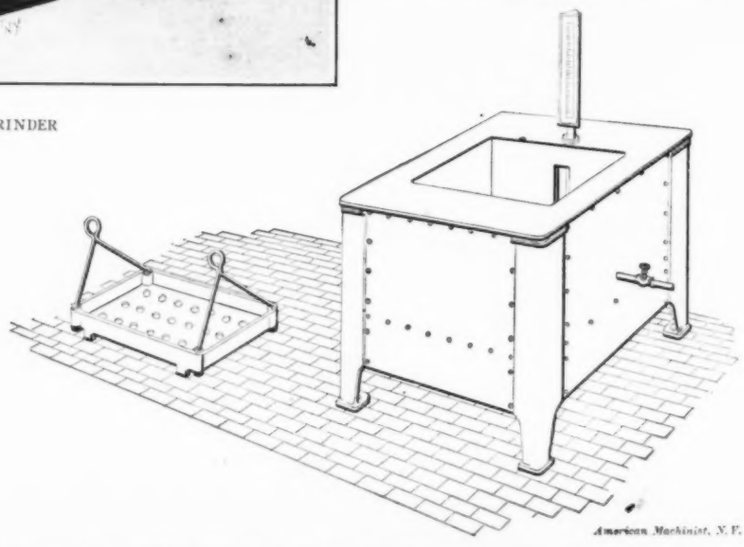


FIG. 2. ELECTRICALLY HEATED OIL TEMPERING BATH SHOWING REMOVABLE TRAY

bath. The second method is to turn on full heat, bring the oil to the desired temperature, then introduce the work, and by means of regulating switches maintain that temperature constant any length of time desired.

Where desired, a cast-iron basket or tray is supplied in which the work can be placed. The basket has eye bolts at each end to facilitate handling. The bottom of the basket is perforated with 7/8-inch holes permitting free circulation of the oil. There are also legs on the bottom of the basket which keep the work an inch or more above the bottom of the bath when the basket is in the tank.

Grouping and Control of Heating Units

The heating units are connected in groups according to the size of the bath, and the leads are brought out to the thermal block. In the single-heat devices each group is protected by a fuse. In the multiple-heat device, the leads are carried to the switchboard, the latter being so arranged that the energy input can be varied in small steps from zero to maximum. A switchboard is not necessary for the single-heat bath, but is required for control where a multiple-heat device is wanted

Any desired temperature is obtained by throwing in the necessary number of units to give the approximate value. Close regulation is then secured by varying the voltage impressed on one of the units. This is accomplished by means of the rheostat mounted on the board. As a result of this method there is a negligible loss of energy in the regulating device. The bath is made in three sizes, varying from 9 to 37 gallons and consuming from 6 to 20 kw. of current. The energy consumption is sufficient to heat the oil to a temperature of 450 degrees in less than one hour, starting cold.

A New Type of Grinding Machine

This is such a departure from the usual form of grinding machine that an outside view conveys very little idea of either its operation or purpose. It is called a chucking grinder, and the name becomes more and more appropriate as we look into the machine and its work.

There are three grinding spindles carried in the head *A* and shown in detail in Fig. 3. Each grinding spindle is independent both as to its drive and horizontal adjustment for its work, this adjustment being controlled by cranks *B*, *C*, or *D*, as the case may be, and its power by the handle *E*, which controls the position of the driving belt inside the machine.

The work is held in a chuck of some sort mounted on the work spindle in the work head *F*, being entirely different in every respect from the usual cylindrical grinder and bearing only a distant relation to the internal grinder as usually known. The handle *D* locks the spindles after they have been adjusted, while the wheel *H* controls the in-and-out movement of the work head *F*. *I* is the handwheel for the cross-feed, *J* the locking lever which clamps the work head, either in line with the spindles or at any desired angle as secured by the graduated disks under the handle *I*. The wheel *K* gives the hand movement of the grinding head and is automatically thrown out as soon as the power feed is thrown in, *L* adjusts the power feed from 1/16 to 5/8 inch for each revolution of the work, while handles *M* and *N* control the speed of the work spindle, while *O* controls the clutch which gives the grinding head travel either to the right or left.

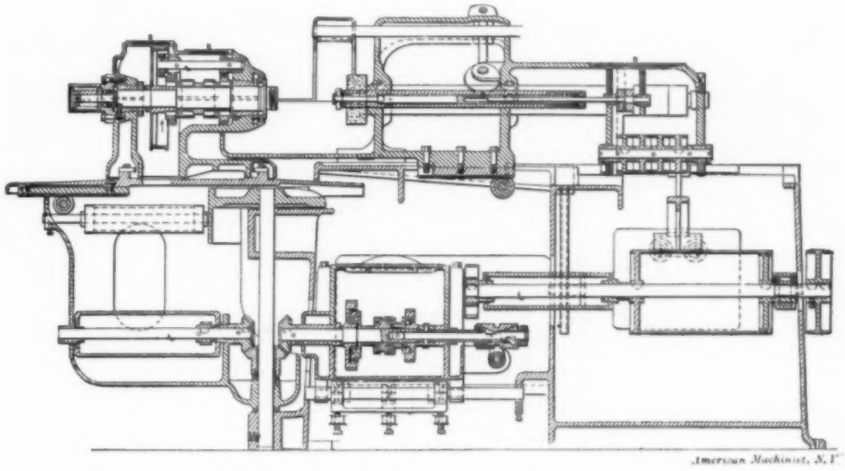


FIG. 2. SECTION THROUGH THE MACHINE

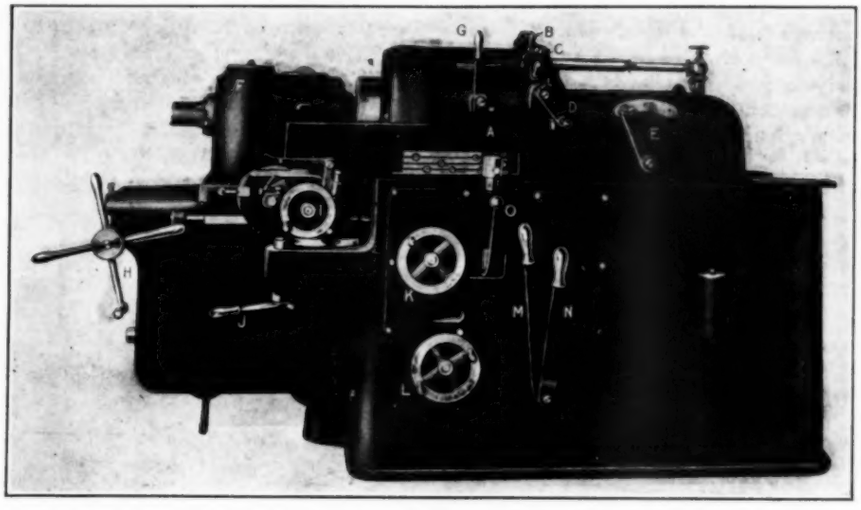


FIG. 1. FRONT VIEW OF BRYANT CHUCKING GRINDER

A Sectional View of the Machine

Fig. 2 gives a better idea of the construction of the machine, showing a section through the work spindle and also through the internal or central grinding spindle. Beginning with a single pulley drive at the end, the power is transmitted to the driving mechanism for the feed of the grinding head, and also for revolving the work at the correct speed. The gearing and clutches shown give nine variations of speed, power being transmitted through the three beveled gears around the pivoting and supporting shaft, and by belt from the long drum to the pulley on the work spindle above. The work spindle is also back-geared, as can be readily seen, these being controlled by the handle on the outside of the work head.

On the main shaft coming in from the single drive pulley outside is a long drum and from this the power is transmitted directly to the two outside grinding spindles above. The center or internal spindle receives its motion indirectly, being driven by a belt from the left-hand pulley on the idler shaft, shown between the main shaft and the grinding spindle. This is arranged so that only one spindle will be in operation at a time, the spindle desired

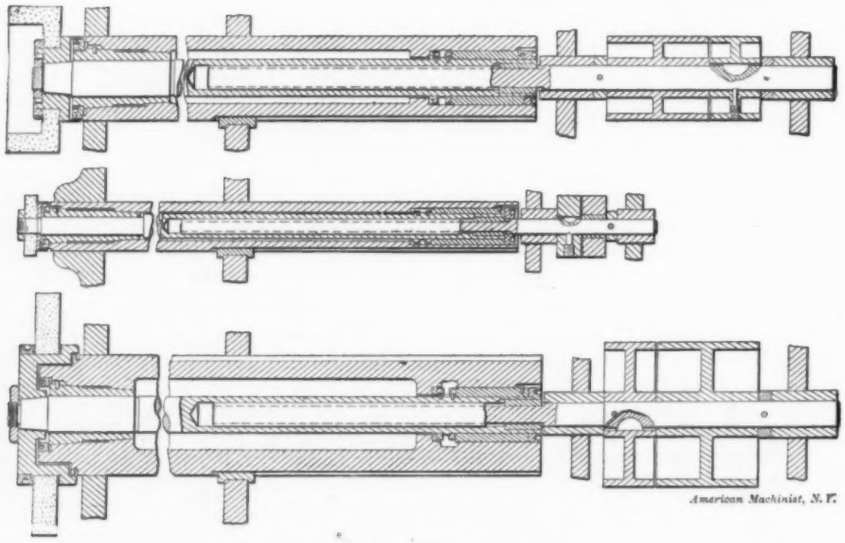


FIG. 3. THE GRINDING SPINDLES

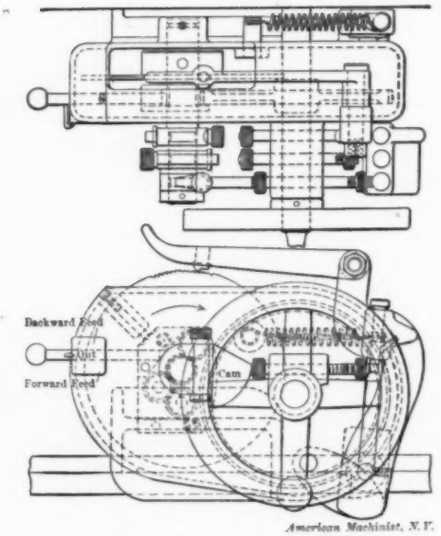


FIG. 5. POWER CROSS FEED

being selected by the position of the handle *E*, which shifts the belts inside the machine.

The Grinding Spindles

The grinding spindles themselves are shown in Fig. 3 in their relative position, from which it will be seen that each spindle is carried in a sleeve and is moved in and out and held in the desired position for the work, together with the sleeve itself. The movement of the whole head keeps the overhang the same after it is once set. They are driven by a splined shaft on which the pulley is fixed, the general construction giving an idea of the substantial bearings and the way in which they are supported.

Fig. 4 shows the ingenious way in which all three spindles are clamped by a slight movement of the handle *G* shown in Fig. 1. It consists of a combination of cone-pointed rods bearing against inclined surfaces and made a free enough fit so as to be self-adjusting in every way and not requiring the extreme accuracy in fitting up that might be supposed. It is an interesting method of transmitting a slight motion in a number of different directions from a central point.

The Work Head

The cross-feeding mechanism of the work head is shown in Fig. 5, and is controlled by the small handle at the left which the indicator shows to be thrown out. Three stops are provided, one for each grinding spindle, and a very ingenious device is used which allows the amount of feed to be gradually reduced automatically so that the last cuts are made with a very light feed, or with it thrown out entirely, assuring accuracy in the finished piece and aiding in duplicating work.

This is accomplished by the use of the cam shown, which is connected with the gear train of the cross-feed screw, and the curved surface of this cam controls the movement of the stop, which in turn limits the movement of the swinging arm carrying the ratchet lever and determines the number of teeth that can be picked up at each stroke. Cams and stops are provided for each spindle, and there are also location stops for the entire work head, which determines its movement toward the grinding spindle in operation. These are independent for each spindle and allow the work to be readily set for any desired operation with the assurance that the pieces will all be duplicated.

The cross-sliding head is mounted and gibbed to an intermediate slide having longitudinal traverse. This intermediate slide is quite thin and no effort was made to have it stiff enough to resist twisting or bending strength. Instead of this the lower gibs that hold slide onto the base are placed directly under the gibs that hold cross-slide to the intermediate, so that any pull or thrust imparted to the work spindle is taken care of by the direct line of gibbing to the base casting itself. In other words, the intermediate slide is in reality

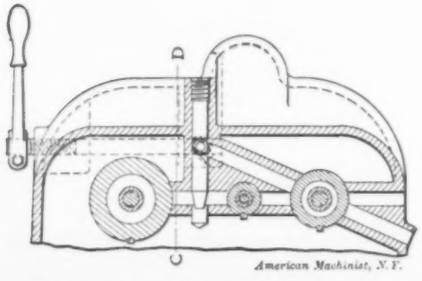


FIG. 4. LOCKING DEVICE FOR SPINDLES

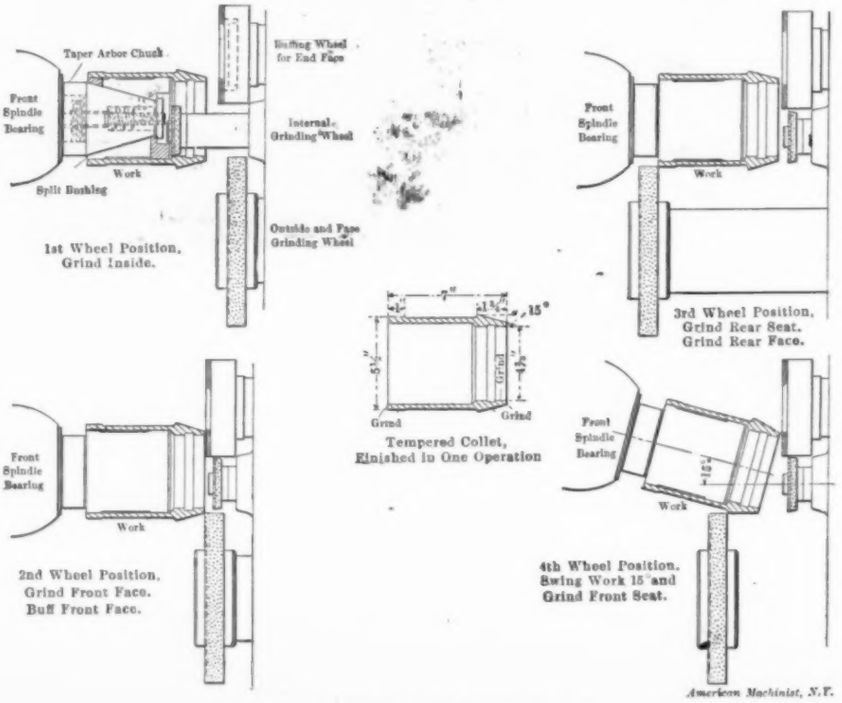


FIG. 6. GRINDING A TEMPERED COLLET

a flexible member, whose flexibility, however, does not in the least affect the control of the cross-slide.

Some of Its Work

Leaving the machine itself and studying some of its operations, we see its field of usefulness much more clearly than before. One of the essential conditions for successful grinding is the right wheel for the work, and this machine allows the proper selection in the same way that a chucking machine has the right tools for every operation.

Taking the work as it comes from the regular chucking machine, either in its natural stage or after heat treatment, this machine offers a way of finishing by grinding with practically the same facility as in the original machining of the piece itself.

Fig. 6 shows very clearly the grinding of a tempered collet, which is all done at one operation, although four grinding-wheel positions are necessary. The first of these shows the collar held on a taper draw chuck and the internal-grinding wheel at work sizing out the nose. In the second position the front face is being ground by the large outside wheel and also being buffed by the wheel on the rear spindle.

In position three, the large wheel is

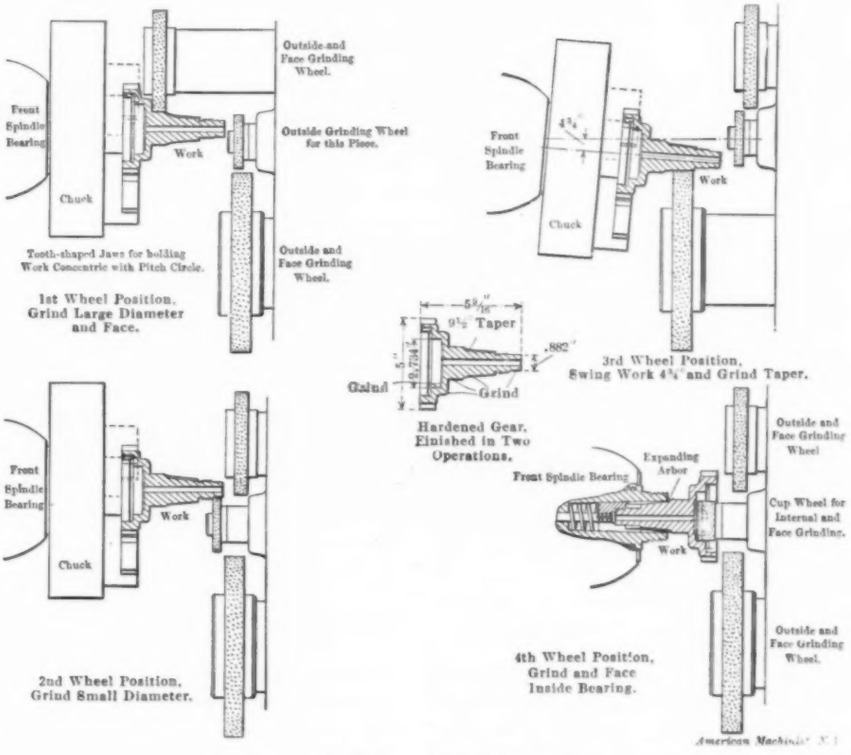


FIG. 7. GRINDING A HARDENED GEAR

grinding the outside and the back face, while in the fourth position the work spindle has been swung to the necessary angle, 15 degrees, and the outside wheel is grinding the tapered front seat. It will be noticed that the whole work head is swung for angular work around the substantial vertical shaft at the end of the body

the third position the work has been swung so that the wheel on the front spindle is finishing the taper portion. It is then necessary to reverse the piece and a small cut wheel on the internal spindle is at work inside the gear.

One can hardly fail to note the way in which this arrangement of grinding spin-

proper, so that the rigidity of the machine is in nowise affected.

Fig. 7 shows a rather complicated grinding proposition in the shape of a special hardened gear with a taper bearing. This is chucked in special tooth-shaped jaws, and the first wheel position shows the back spindle at work. In the second position the small internal wheel is doing external grinding on the small diameter, while in

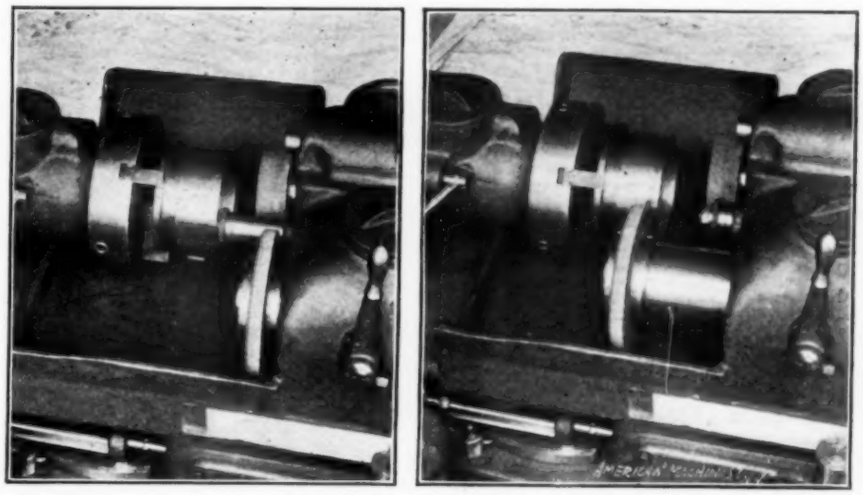


FIG. 8. A PIECE OF WORK IN POSITION

dles seems to adapt itself to work of this kind, and it is somewhat surprising to see the small amount of cross-movement necessary to bring either of the desired wheels into action. It is not by any means necessary to follow the arrangement of wheels shown in these illustrations, although for most purposes they will probably be found most convenient, but any desired combination can be used which seems best adapted to the particular work in hand.

An auxiliary fourth spindle is provided for grinding out small holes and can carry wheels small enough to enter a ½-inch hole. This may also be used to carry wheels for outside grinding, or for polishing. The machine will grind a piece 12 inches in diameter and 12 inches long. It is regularly supplied with 10-, 6- and 3-inch wheels by the makers, the Bryant Chucking Grinder Company, Springfield, Vt.

Examination for Junior Engineer

The United States Civil Service Commission announces an examination on November 23-24, 1909, in a large number of cities to secure eligibles from which to make certification to fill vacancies as they may occur in the position of junior engineer in the Geological Survey, at salaries ranging from $840 to $1200 per annum. The vacancies to be filled in the junior engineer grade are in three distinct lines of employment: (1) For testing structural materials, for which an educational groundwork corresponding to the degree of civil engineer or B. S. in civil engineering should qualify the applicant; (2) for testing fuels for which an educational groundwork corresponding to the degree of mechanical engineer or B. S. in mechanical engineering should qualify the applicant; and (3) for the investigation in the field of methods of mining and production of fuels and structural materials. Applicants should at once apply to the United States Civil Service Commission, Washington, D. C.

Machine Slides

By J. Richards

This brief article is to contain a moral, also a tale, and in addition, it is hoped, some useful suggestion on sliding joints in machines, especially machine tools. It relates to all kinds of guides and ways in general and to a branch of fitting or design that everyone has interest in and one that, so far as I know, has only an empirical base and no rule, scientific or other.

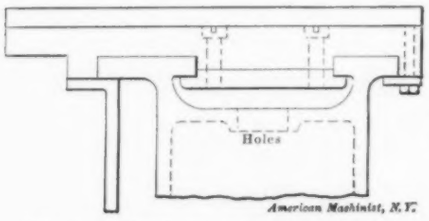


FIG. 1. GIBBING OF A LATHE CARRIAGE

First for the tale, however, and then the comments, because the tale made a foundation for some tolerably hard thinking, not yet quite done. Many years ago, a young man, trained in the American manner of mounting lathe carriages on angular or V ways, when visiting a friend who was the master mechanic of a railway in northern Europe, was invited to inspect a new lathe in the works recently received from Sir Joseph Whitworth's, Manchester, England, and at once, or on first view, set out on a disquisition upon the absurdity of not mounting the carriage on angular ways, so it would move easily, true and steady, and not gib it over the frame in that old-fashioned manner.

The master mechanic, a polite and older man, remarked that he had some lathes made that way, but he used them for light work only, because the carriages, being held by gravity only, would not stand any but downward strain.

The angular-way proponent asked for a pinch bar and, inserting it in a bolt slot of the carriage, attempted to shake it all about, but could not. It was as solid as the rock of Gibraltar and moved not. "Well," said the visitor, "it will not slide when gibbed down in that manner." The master mechanic said nothing, but unlocked the feeding gearing, moved back the movable head and then said, "Try it." The carriage moved with perfect freedom with the rack, but the older man then put his hand on the carriage and slid it from end to end as if it was on rollers.

The writer, who was the visitor, went back and sat down to think and is thinking yet, perhaps usefully—a point to be decided by readers here and now in this advanced time.

Two Methods of Fitting

To trace these two methods of fitting, one can begin with the manner of fitting up sliding joints here and in the shops of European makers, especially in Great Britain. By two methods is meant in one case a saddle or carriage is put on and scraped down to a fit on its own seat; the other where the frames or seats of moving carriages are "got up" independent of the sliding carriages or mountings.

To illustrate by a concrete example, let us suppose a dozen lathe beds are to be got out in a machine-tool works in England—one where good tools are made, as distinguished from a merchant shop, of which there are happily not very many. The frames or beds are "lined" by the fitters and planed, then are made true and parallel by straight-edges, surface plates and dummy carriages, ready to receive their mountings.

This is in accordance with the old rule (and a true one), that no two pieces that are to work together can be fitted together, also the old custom of fitting three or more instead of two surface plates together. These frames are then, after inspection, turned over to the fitters.

The main point is the interchangeable system of fitting; this mention of the surface plates introduces another tale that may have some hints in relation to the present subject.

Mr. Porter, one of the brightest mechanics of his time, after a trial at making high-speed steam engines at Whitworth's Works in England, came over to New York and founded the Porter Engine Works, away out about the Harlem river, forty or more years ago. He had at Whitworth's seen some nice fitting and concluded he would introduce it here, and got up, accordingly, a system of straight-edges, surface plates and so on for sale, putting at them his best men; but it would not do. The tools "went into wind," would not fit and Mr. Porter, in his desperation, sent over to Mr. Sincock, at Manchester, for a workman to "call off the witches," as Mr. Porter termed it, and one came accordingly—a plain-looking workman, who did not know what he was to do.

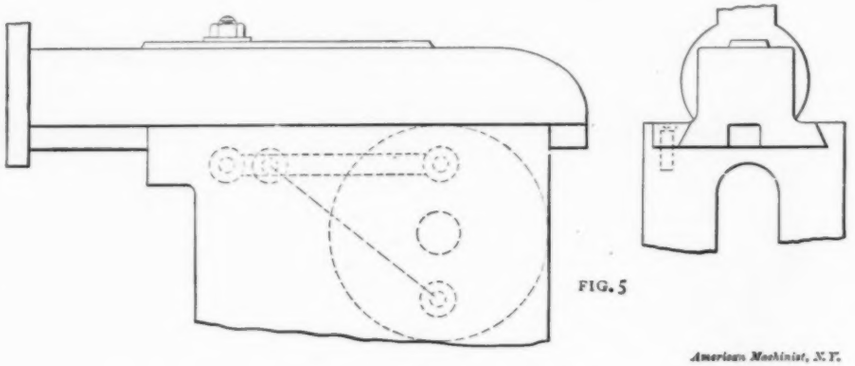
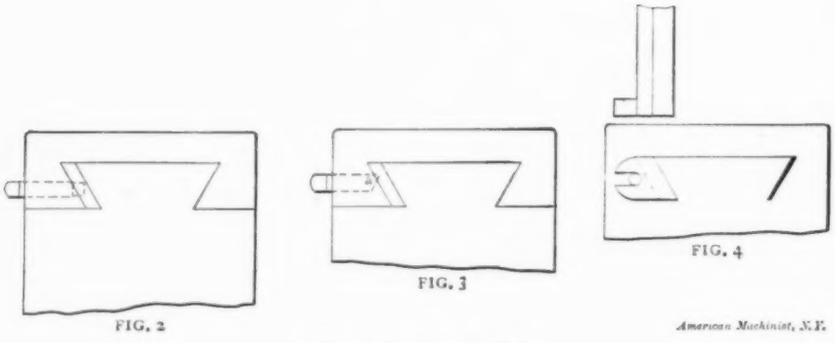


FIG. 5. GIBBING FOR A SHAPER RAM



THREE FORMS OF GIBBING

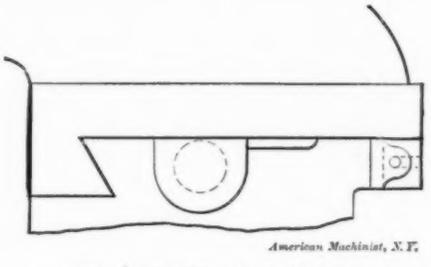


FIG. 6. GIBBING OF A PLANER

Two straight-edges, about 3x24 inches, were given him to finish or fit. He looked them over, said "they were pretty good," reached up to his head, pulled out a hair, laid it across the faces, and then swung them obliquely each way, so the diagonal corners would catch and the whole trick was at once seen. The plates were all trued up in a few hours and, as Mr. Porter once informed the writer, he went out to find someone to "kick him for stupi-

dity." These men at Whitworth's had learned to true up surfaces. So had Mr. Porter.

These systems of fitting, to a great extent, are a result of the manner of laying out work. In England, for example, fitters are the mechanics. Lathemen, planing men and drillers rank between the fitters and laborers, have little to do with the drawings or where things go after they are machined to lines made by the fitters. In this country a machinist is supposed to know and perform all branches, has drawings to work to, while the fitters or benchmen put the work together. Which way is best is not to be argued here; but the reasons for mounting sliding parts on angular or A or V guides contrasted with gibbing on solid, in all planes is a problem of expense, the customs in fitting, the uses of the machine and is fortunately confined to lathes mainly.

The safest conclusion is that all the methods in use are good and suitable when considered in respect to certain premises. The report of Prof. John E. Sweet on "Machine Tools at the Centennial Exhibition of 1876" no doubt contained valuable and exhaustive information on the subject of mounting the sliding parts of such implements; but this report was for some reason not printed and never saw the light, much to his regret, as well as of his friends.

Some Methods of Gibbing

I send with this some diagrams of "gibbing" in the Wild and Woolly West; some of them novel perhaps.

Fig. 1 is a lathe carriage, with a box frame, which was very rigid and kept its alinement.

Fig. 2 was a "humbug," so called because it held nothing, the screws being seated "square" against the gib and holding but little. They were changed as at Fig. 3 with beveled ends to change the pressure to the line *a* and did well. Finally, however, the wedge as at Fig. 4 was adopted, which was good enough in all cases.

Fig. 5 shows the gib and method of driving for a simple shaping machine with a modified "quick return" movement that worked very well and cost nothing.

Fig. 6 shows the gibbing of a side planing machine where the strain was mainly torsional in a horizontal plane and quite severe. The result was great endurance.

The whole matter of gibbing seems to narrow itself down to getting ample surface and providing rigid compensation, as nearly as possible normal to these surfaces, also substituting set screws with wedges when practicable.

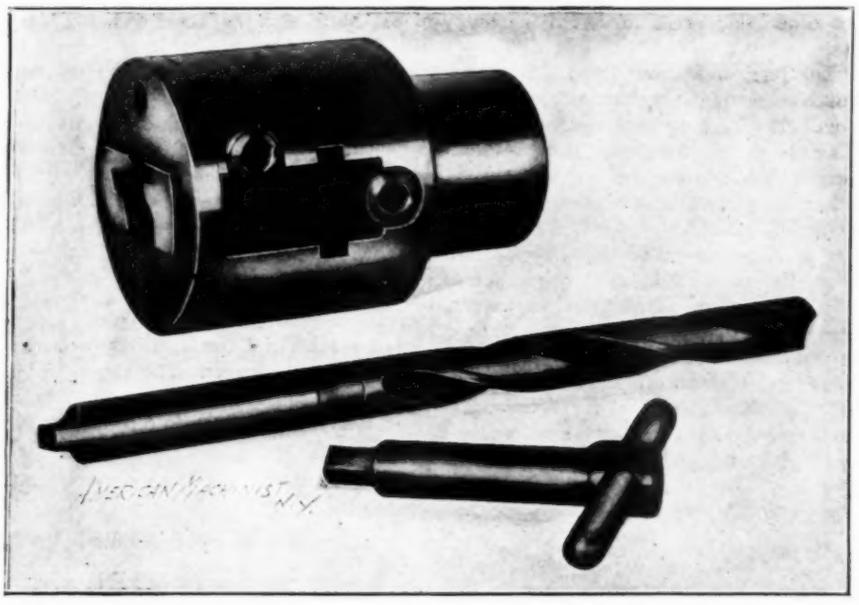


FIG. 1. GERMAN DRILL CHUCK, AND TANGED STRAIGHT-SHANK DRILL

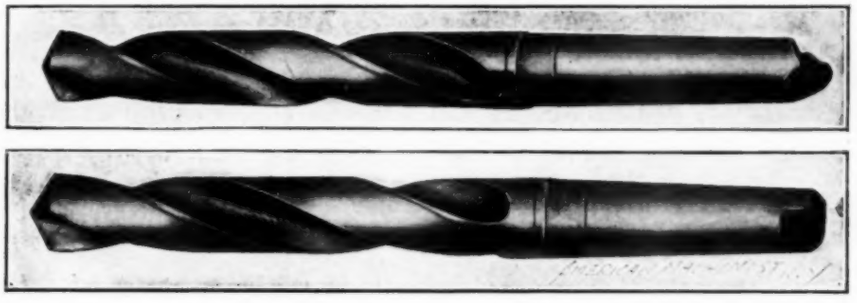


FIG. 3. WAY IN WHICH NEW TANG IS MADE ON A DAMAGED DRILL

A German Drill Chuck

By W. Pockrandt

While twist drills with taper shanks generally have a tang on the end, which bears against projections in the chuck and thereby produces a powerful drive of the drill, until now this device has not been tried with straight-shank twist drills. The firm of Ludwig Loewe & Co., Berlin, Germany, has produced, since the time when it began to make twist drills of high-speed steel, straight-shank drills with such a tang (see the drill shown in Fig. 1), and brought out therefor a suitable drill chuck, which gives a powerful drive to the tool and makes possible the full use of its working capacity.

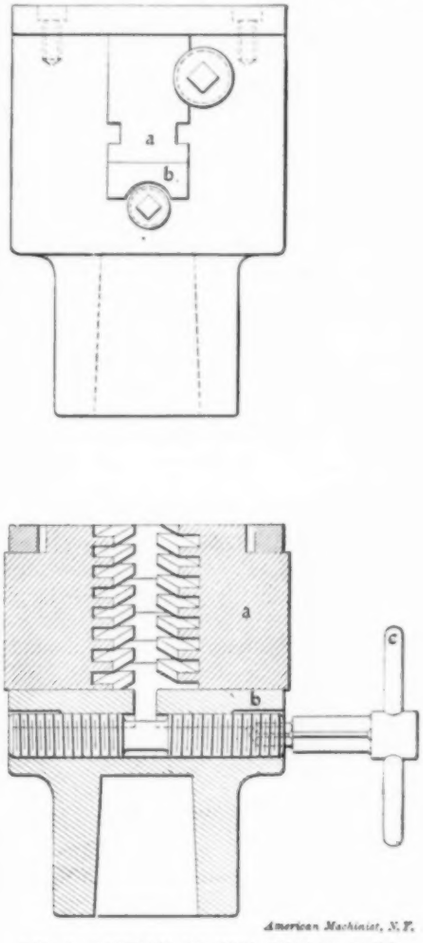


FIG. 2. DIAGRAM OF NEW GERMAN DRILL CHUCK

The chuck has two pairs of jaws independent of each other. The upper and broader jaws *a*, Fig. 2, serve only to centralize and to fasten the tool in an axial direction, while the lower jaws *b* give the

powerful drive. The upper pair of jaws does not require to be tightened very hard; the lower jaws can, on the other hand, as they are not used to centralize the tool, even have some play over the faces of the tang and rest against the driving faces in a radial direction. For both sets of jaws only one wrench is required. The chuck can be used for straight as well as for taper shanks.

If anyone wishes to keep uninjured Morse taper shanks he can have a chuck with suitable tapered jaws. Tools with damaged Morse taper shanks can be used. This is especially true for taper-shanked drills of high-speed steel where the tang has been broken (see Fig. 3). While such drills are worthless in the ordinary drill chuck they can be brought fully into use by our own chucks. It is only necessary to make a new tang on the shank, which, however, need neither be accurate as to breadth, nor length (see Fig. 3).

Jerry Wise and the Perfect System

By J. H. Vanplesenter

Jerry Wise was smoking a fat cigar. His office chair was tilted back at a comfortable angle, and his feet reposed on the deck of the big roll-top desk, serving also as paper weights for a pile of correspondence. Through a window in the side of his office, Jerry could dimly see the outlines of the big planer, and now and then catch sight of a will-o'-the-wisp spark, as the night watchman crossed and recrossed the shop with his lantern.

The Star Engine Company had reached a point in its development where Jerry found it hard to keep in touch with the fast growing detail. He saw the time approaching when he must employ more efficient and modern methods in his organization, and had spent most of the day in conversation with a firm of "system doctors" from the city, who drew beautiful pictures of a modernized Star Engine Company. Jerry's brain was filled with "automatic routing," "perpetual inventory," "daily profit statements" and other luxuries of a system in which his chief exertion would be to carry the money to the bank. It made him a little dizzy to think of it; the office was rather hot, too; possibly it was the combination of these circumstances that caused him to close his eyes for a moment.

Gradually, and how long after this he cannot state, Jerry became aware of a dull hum which appealed familiarly to his ear. He started from his chair, realizing that the line shafts and machinery were in motion. Knowing that he and the night-watchman were alone in the plant, he was somewhat startled, and hurried to the door leading from the office to the engine room. "The engineer must be drunk," was his comment as he opened it.

The Engine under the Perfect System

Apparently no one was in the engine room, although the big Corliss was running with its accustomed swing of rod and chug of dash pots. "Possibly in the fire hole," muttered Jerry, and glanced through the opening leading to the boilers. Something was moving in the shadow of the coal pile and he heard the sound of a shovel grating in the coal. "What in—" Jerry started an exclamation but the words died on his lips as he saw, not the engineer but a shovel, well filled but unattended by human hands, glide through the space between the coal pile and the boiler, and deliver its load into the open furnace door with a skilful fling. "I'll be—" started Jerry again, but broke off as the shovel repeated its performance and then banged the fire door shut with its handle. "That beats an automatic stoker," said Jerry. "Best shovel we ever had, must look in the morning and see where we bought it."

Assured by this time that he was not the victim of a trick, and prepared for further surprises, Jerry marched to the shop door. Dark forms were flitting through the building and the groan and shriek and turmoil which filled his ears as he opened the door, told him that iron was being cut at a rate never before approached in his plant.

The Planer under the Perfect System

He stopped at the side of the big planer, which was not in motion, just in time to see a heavy frame approach with a smooth gliding motion, and jump gracefully on the table of the big machine. "I didn't need that overhead traveling crane after all," sighed Jerry, as he watched the wedges and bolts glide into place and fasten the big casting securely. A moment later the cut started, and Jerry made a mental note of the cutting speed for the subsequent information of his foreman. He guessed it to be about 200 feet and expected to see the downfall of the tool after the first stroke, but it made a half dozen while he stood there and was apparently as good as ever.

As he walked down the shop, stepping aside occasionally to allow an animated casting to pass, his attention was directed overhead by a peculiar rustling and fluttering. A stream of papers met his gaze, flying along as though impelled by a strong breeze. It was not difficult to reach up and catch a handful, and doing so he discovered that the papers were time cards and shop orders for the work in process. Releasing the captured papers he watched them continue their flight and disappear through the open office door.

By this time Jerry was incapable of further astonishment. He began to realize that he was in the presence of a perfect system, and resolved to keep his senses alert to grasp as much of it as possible.

A Lathe under the Perfect System

Arriving at the heavy reduction lathe he noticed that it was running on the highest speed. The stock being turned was a forged shaft six inches in diameter, and on measuring with his pocket rule, Jerry found the cut to be one-half inch with one-eighth feed. Both shaft and tool were red hot, and the chip came off at a white heat, but apparently without injurious effect to the machine or the work. In fact the heat of the chip was well utilized as Jerry saw when he followed that continuous curling spiral with his eye to where it passed over the anvil of a power hammer a few yards distant. Here under swift blows it was dressed down to one-quarter inch round, snapped off into 16-foot lengths, and fed directly into the chuck of an automatic screw machine which was engaged in converting the bars into quarter-inch studs. "No waste of materials under a perfect system," murmured Jerry.

The Boring Mills under the Perfect System

The vertical boring mills were apparently engaged in a combination speed contest and vocal concert. The grunt, shriek and squeal of fast cutting on the several machines resolved itself into a familiar air that seemed to say:

"It looks to me like a big night tonight,
Chuck it up tight, take a big bite.
When the system's in play
All the tools earn their pay;
It looks like a big night tonight."

Grinding Versus Milling under the Perfect System

The milling machines were not running, an exception that evening which rather surprised Jerry who had an idea that this class of machine was among the most efficient in his shop. The explanation came shortly as he arrived at the door leading to the casting storage department. Here several emery wheels were located. Each casting as it floated in from the storage department paused at a wheel and rubbed against it at various angles, thus obtaining smooth surfaces on those parts where finish was required.

This was an eye opener for Jerry. He figured out the machine-hour rate both on the depreciation basis and on the square foot of floor-area basis, and found it the lowest he had ever known. Then he made a mental note to trade in all his milling machines for their equivalent in emery wheels and so establish this low machine hour rate firmly in his shop.

While standing here Jerry was given an illustration of the way in which a perfect system will automatically adopt expedients for the quick handling of rush orders. A crank-shaft forging came down the gangway at an unusually rapid pace. Attached to it was a red tag which denoted "Express Order, Immediate." Instead of continuing to a crank lathe as Jerry expected, it stopped at one of the wheels rudely bumping to one side a pair

of connecting-rod wedges which were undergoing the operation of automatic grinding. Here it revolved slowly, and at the same time traversed across the face of the wheel, emitting a shower of yellow sparks until the bearings were smoothly ground to size. Then changing its motion, it oscillated about the crank pin, finally completing the process by a rub on either side of the throws. The whole operation consumed about six minutes, which Jerry observed was slightly better than the time allowance which the systematizers had recommended for a four-by-four crank. He watched the express order leave the wheel, plunge into a tank of slushing compound, emerge with a shake and finally disappear through an open window in the general direction of the local express office.

Assembling under the Perfect System

Jerry was now ready to investigate the methods of assembling in vogue under a perfect system, so continued his tour in the direction of the erecting department. On either side of the approach to this department were racks in which the finished parts for the various engines manufactured by the Star Engine Company were commonly stored. As a rule these racks were rather incompletely filled, as the factory found it difficult to work up stock in advance. Now, however, to Jerry's delight, they were well crammed with a fine assortment of parts. As he stood there congratulating himself on the excellent showing of stock, a frame and cylinder completely machined came into view moving slowly but easily toward the erecting floor. As it came opposite the stock racks a crank shaft shook itself free from its fellows in one of the bins and jumped into the bearings, followed by a pair of bearing caps and the necessary studs and nuts, each from the proper bin. The crosshead, piston, piston rod and cylinder head followed suit, so that by the time the engine had passed the last bin in the finished stock racks it was completely assembled, and that without once interrupting its steady glide.

Jerry reflected upon the expeditious method of assembling he had just observed and noted that it was in accordance with the principles expressed that morning by the representatives of the system firm. "Arrange your shop routing in such manner that the feeder sections will discharge the supplementary product of details into the finished-stock department, and thence to the floor, thereby interfering as little as possible with the natural trend of the heavy parts from their initial entrance at the casting shed door, to their final destination, the shipping department."

The Office under the Perfect System

Having completed the tour of the shop, Jerry suddenly remembered the flying papers which had disappeared through the office door and decided to retrace his steps and see what the automatic system was accomplishing in that field. As he entered he heard the rapid click of typewriters, and saw a long roll of tape proceeding from an adding machine. Several automatic pencils were busy rating and extending time cards which, after being figured, gathered themselves into groups representing complete costs, and into other groups representing subdivisions of expense.

Jerry seated himself in the chair which he had left some hours before, and reflected with satisfaction on the extremely inexpensive, expeditious and industrious office force surrounding him. Applications for raise of salary and vacations were now a thing of the past. He lit another cigar and puffed away comfortably. After a lapse of a few moments the adding machine ceased operating and its roll of tape detached itself and proceeded to the billing machine, which immediately started to write the profit statement for the evening's work. When complete the sheet fluttered over to Jerry, and he read as follows:

PROFITS UNDER THE PERFECT SYSTEM.

Profit statement for night of.....1909
Star Engine Company.

Materials:	
Cast iron, 500 tons at $40.....	$20,000.00
Forgings, 60 cwt. at $5.50.....	330.00
Purchased miscellaneous.....	5,683.29
Payroll:	
Mechanics and helpers.....	000.00
Superintendent, foremen, assistant foremen.....	000.00
Engineer and firemen.....	000.00
Watchman	1.75
Power, Light and Heat:	
Coal, 6 tons at $2.....	12.00
Depreciation	30.00
Interest	20.00
Miscellaneous overhead.....	10.00
Total manufacturing expenses	$26,087.04
Total Valuation of Goods Produced:	
Completed engines.....	$40,278.99
Increase of inventory of parts figured on regular margin of profit over cost.....	10,345.36
Total	$50,624.35
Net Profit for night of.....1909	$24,537.31
Net profit, preceding day, (comparison).....	12.62
Value of a perfect system in your shop, expressed in profits per hour.....	$2,452.47

Jerry chuckled to himself. "Guess I'll send those systematizers back to the woods tomorrow. They can't beat this!"

Just then something hit him hard on the back of the head. His chair had upset, and when he struggled to his feet, covered with cigar ashes and chagrin, the shop was quiet and the typewriters had ceased their click, for Jerry was awake once more.

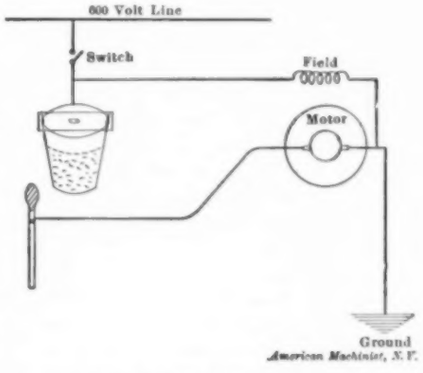
A largely increased activity in the industrial field is indicated by the September figures of Internal Commerce as reported to the Department of Commerce and Labor. The improvement is most pronounced in the coal and iron trades. The pig-iron production during the month, 2,385,206 gross tons, was the largest monthly output ever recorded in the annals of the trade. At the present rate of output the production for the year is likely to approach, if not equal, the 1907 production of over 25,000,000 tons.

A Water Pail Starting Box

By Earl R. Filkins

We have in our station a 2½-horsepower shunt motor driving a drill press. It takes current at 600 volts from a street-railway circuit. The other day the starting box burned out and was sent to the repair shop. Before it came back it became necessary to use the drill press and I rigged up the following water-rheostat starter which operated very successfully for a couple of days until the regular box came back. Perhaps some other readers may find the idea of use in times of emergency.

I took an ordinary galvanized water pail and laid over it a board about 6 inches wide, driving a nail through each end to prevent slipping off. Now through the center of the board I bored a hole large enough to easily pass an inch pipe. I cut the pipe long enough so that when



A WATER-PAIL MOTOR STARTING BOX

one end rested on the bottom of the pail the other extended about an inch above the board. Then I drove a wooden plug into the top of the pipe for a handle. I now brought a wire from the inside line switch and connected it to one of the ears of the pail. I also tapped my motor field to this lead, as shown in the sketch. I also ran a wire from the armature terminal of the motor and wrapped the end around the top of the pipe just below the handle.

I now filled the pail about three-fourths full of water, closed the line switch, and holding the pipe by the wooden handle shoved it down through the hole in the board until the lower end just touched the water in the pail. Holding the pipe so that the end was just under water I put in salt, a pinch at a time, until the motor began to turn over. Now on pushing the pipe down until it rests on the bottom of the pail the motor comes up to speed, and may be run in this position as long as desired.

To stop, open the line switch and pull out the pipe. Care must be taken not to close the switch with the pipe in the pail. The line switch must always be closed be-

fore the pipe is inserted. This device may be used on a full metallic circuit by running the wire marked ground to the second wire of the line.

Annealing High Speed Steel

By Walter G. Groocock

Several short articles on the above subject have appeared in the American Machinist, and all have advocated packing the material in a box with some non-conducting substance.

We have been using high-speed steel since its introduction, and although our yearly consumption is several tons, and the number of the brands that have been used runs well into double figures, we have never packed any. We simply place it into a gas furnace at night, of a type similar to those of the American Gas Furnace Company's; raise it to between 1400 and 1500 degrees; let it cool down in the furnace and take it out about 10 o'clock the following morning, as then it is cool enough to handle.

This gives us a steel that is thoroughly soft, so soft, in fact, that we cut it, both in the lathe and on the milling machine, at a speed in excess of any we can use on carbon steel. It might be mentioned that we reanneal nearly all of our cutters after rough-machining, and by this means have reduced our losses from cracking to the vanishing point.

Our only complaint is that sometimes it is too soft, for on such tools as taps, or hobs, where it is especially desirable to have a smooth finish, when too soft the material shows a tendency to drag. With carbon steel this can be got over by water annealing, but with high-speed steel it is best overcome by using a lubricant composed of equal parts of Axiam oil and turpentine.

Forthcoming Meetings

National Gas and Gasolene Engine Trades Association, Chicago, November 30, December 1 and 2. La Salle hotel. Albert Stritmatter, secretary, Cincinnati, O.

National Society for the Promotion of Industrial Education, annual convention, December 1, 2 and 3, Milwaukee, Wis. J. C. Monaghan, secretary, 20 West Forty-fourth street, New York City.

American Society of Mechanical Engineers, annual meeting, New York City, December 7-10. Calvin W. Rice, secretary, United Engineering building, New York City.

Business Items

The Robertson Drill and Tool Company has moved into its new factory, corner Grant and Letchworth streets, Buffalo, N. Y.

The D. Nast Machinery Company has opened an office at 368 Bourse building, Philadelphia, and will handle a line of new and second-hand machinery.

The Pawtucket Tool Company, Inc., Pawtucket, R. I., has been incorporated, and is starting to make automatic tapping chucks, tapping machines, special tools and fixtures. The officers are E. J. Ashcroft, president; E. D. Thompson, secretary and treasurer, and Jos. E. Dalton, sales manager.

Business Opportunities

John Beck, Ashland, Wis., will build a refrigerator factory.

The Rockton (Ill.) Paper Mill was burned. It will be rebuilt.

The Fort Atkinson (Wis.) Glove Company will install motors.

The Bayfield (Wis.) Mill Company will erect a new sawmill.

The Turner Heater Company, Bristol, Conn., is erecting an addition.

The Cleveland (Ohio) Tanning Company is building a new tannery.

The Butler Hospital, Providence, R. I., is building a new power house.

The Oriental Mills, Providence, R. I., is making extensive alterations.

The Marks Shingle Mill, North Menominee, Mich., was destroyed by fire.

The plant of the Dayton (Ohio) Computing Scales Company was burned.

The H. B. Davis Paint Company, Baltimore, Md., will build a new plant.

The Sterling Engine Company, Buffalo, N. Y., is erecting an addition.

Jos. Bancroft & Sons Company, Wilmington, Del., is enlarging its bleachery.

The Pantzer Lumber Company, Sheboygan, Wis., is to build a new plant.

The Antigo (Wis.) Confectionery Company will erect an additional building.

The Wausau (Wis.) Excelsior Company will build an addition to its plant.

The Oxford Linen Company, North Brookfield, Mass., is building an addition.

The Altus, Roswell & El Reno Railroad will erect a roundhouse at Altus, Okla.

The J. E. Bolles Wire and Iron Works, Detroit, Mich., will erect an addition.

The Michigan Elm Hoop Company, Marinette, Wis., will build a store plant.

The Eau Claire (Wis.) Trunk Company will erect a new factory next spring.

The sawmill of the Polar (Wis.) Manufacturing Company was destroyed by fire.

The Willow River Lumber Company, New Richmond, Wis., will build a new mill.

The Milwaukee (Wis.) Car Manufacturing Company will erect a $15,000 addition.

The Scott & Howe Lumber Company, Ironwood, Mich., is building a new sawmill.

The Congealed Ice Company, Providence, R. I., is preparing to erect a new plant.

The Webb Jay Motor Company, of Chicago, Ill., will build a plant in Dunkirk, N. Y.

The Monongah Glass Company, Fairmont, W. Va., will erect an additional factory.

The Love Manufacturing Company, South Rockford, Ill., is building a new foundry.

The New York Baking Powder Company will erect a factory in Jersey City, N. J.

The U. S. Headlight Company, Buffalo, N. Y., will double the capacity of its plant.

The Fond du Lac (Wis.) Church Furnishing Company will remodel its machine shop.

J. M. Spear and Chester Baldwin will establish a machine shop at Plainfield, Mass.

The plant of the Delaware Maine Supply Company, Wilmington, Del., will be enlarged.

The Nangatuck Conn.) Malleable Iron Company will erect a plant in Wilmington, Del.

The Alfred Dolge Felt Company, Dolgeville, Cal., will erect an additional factory building.

The Wheeling (W. Va.) Traction Company contemplates erecting additional shop buildings.

The Great Lake Engineering Works, Detroit, Mich., will erect a plant at Ashtabula, Ohio.

The Roxford Knitting Company, Philadelphia, Penn., will erect an addition to its plant.

The Titanium Alloy Company, Niagara Falls, N. Y., will erect an addition to its plant.

The Star Corundum Wheel Company, Detroit, Mich., will erect an addition to its plant.

The French Worsted Spinning Mills, Woonsocket, R. I., will erect an addition to its plant.

The Richardson & Boynton Company, Dover, N. J., manufacturing stoves, will enlarge its plant.

The plant of the Bridgeport (Conn.) Forge Company was destroyed by fire. Loss, about $100,000.

N. G. Preston, Neenah, Wis., will build an addition to the Palace laundry. Machinery is needed.

The National Bronze and Aluminum Company, Cleveland, Ohio, is making an addition to its plant.

The Rea Electric Vehicle Company, Springfield, Vt., is erecting a plant to manufacture automobiles.

The town of West Boylston, Mass., has voted to build a municipal electric-light and power plant.

The Deemer Steel Company, New Castle, Del., is rebuilding an old plant to be used as a steel mill.

The Chester Bobbin Spool Shuttle and Supply Company, Chester Depot, Vt., is fitting up a new plant.

Stone & Wood, Woodsville, N. H., lumber manufacturers, will build a finishing and dressing mill.

The Eagle Aluminum Manufacturing Company, Eagle River, Wis., will build a factory at Green Bay.

The F. J. Greene Engineering Works, Racine, Wis., is having plans drawn for a new machine shop.

The factory of the Federal Tool and Supply Company, Alton, Mo., was destroyed by fire. Loss, $25,000.

The Manistique (Mich.) Brewery was burned. Loss, $26,000. Hutteman & Kraemer, Detroit, owners.

The Entwistle Manufacturing Company, Rockingham, N. C., has awarded contract for erection of a mill.

The Minneapolis (Minn.) Sash and Door Company is having plans prepared for a new five-story building.

The Hollenbeck Manufacturing Company, Holdredge, Neb., is planning the construction of a new foundry.

The Ferry Cap and Set Screw Company, Cleveland, Ohio, is making alterations and additions to its plant.

The Holbrook Manufacturing Company, soap manufacturer, is erecting a large plant in Jersey City, N. J.

Wm. A. Salter Motor Company, Kansas City, Mo., will erect a plant for the manufacture of automobiles.

The plant of the Pioneer Graphite Company, at Junction City, Wis., was destroyed by fire. Loss, $25,000.

The E. B. Holmes Machinery Company, Buffalo, N. Y., making cooperage machinery, is building an addition.

The Standard Lock, Nut and Bolt Com-

pany, of New York, has bought site in Woodbury, Conn., for its plant.

The Ferro Machine and Foundry Company, Cleveland, Ohio, has awarded contract for the erection of a new building.

The Ivins, Dietz & Metzger Company, Philadelphia, Penn., carpet manufacturer, is building an addition to its factory.

The lumber plant of the Traverse City (Mich.) Manufacturing Company was destroyed by fire. Loss, $25,000.

The Twin State Gas and Electric Company, Brattleboro, Vt., will alter its plant and install new electrical apparatus.

The Fisher Manufacturing Company, Fisherville, Mass., manufacturing drapery, etc., is erecting an extensive addition.

The United States Metals Refining Company, Carteret, N. J., will erect an additional building for the refining of lead.

The plant of the Lake Superior Lumber and Box Company, Ashland, Wis., was destroyed by fire. Loss, $50,000.

The Fillmore Avenue Foundry and Iron Works, Buffalo, N. Y., contemplates improvements and additions to its plant.

The Western Wheelbarrow Manufacturing Company, Armourdale, Kan., will rebuild its plant burned several months ago.

The Middletown (Penn.) Car Company has increased its capital stock for the purpose of making improvements to its plant.

C. Fairbanks & Co., of Lafayette, Ind., has purchased site in Alton, Mo., on which a straw-paper factory will be erected.

A new machine shop will be built at the Brotherton mine, Wakefield, Mich. C. E. Walton, Wakefield, is superintendent.

The Atlantic Coast Line will erect a car-repair shop at Rocky Mount, N. C. E. B. Pleasant, Wilmington, N. C., chief engineer.

It is reported the Denver (Colo.) Tramway Company will erect a foundry, forge shop, woodworking and machine shop this winter.

The Kelly Canning Company, Waverly, Iowa, will soon commence the erection of a new factory to replace the one recently burned.

The Veerac Motor Company, Minneapolis, Minn., capitalized at $400,000, will erect a plant for the manufacture of a light delivery motor car.

C. P. Kimball & Company, Chicago, Ill., manufacturing automobile bodies, electric carriages and vehicles, has secured site on which a new plant will be erected.

The United States Brake Shoe Company has awarded contract for the erection of a new building at Corry, Penn., to be used as a foundry and for manufacturing.

The Empire Iron and Steel Company, Niles, Ohio, will commence operations on additions to its plant which will almost double the output. Two new hot mills will be added.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., November 12, for pumping plant, pipe-cutting machine, steel tubing, etc., as per Circular No. 542.

The Rummel Machine Screw Company, Cleveland, Ohio, capitalized at $20,000, has established a plant at Keyes and Edwards streets for the manufacture of machine screw products. Need some screw machines.

The committee to investigate the needs of the Marblehead (Mass.) electric light and power plant recommends the town to make an appropriation of $28,000, of which $13,000 is for additional equipment and balance for renewal and rearrangement.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: November 9—Leather belting, belt lacer and laces, universal index centers, lathe chucks, milling-machine chucks, carborundum wheels (schedule 1851), gasolene engine (schedule 1842), general alarm gong system (schedule 1846), soft sheet brass, sheet copper, condenser tubes (schedule 1856), pipe fittings (schedule 1855), steel tubing (schedule 1852).

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: November 16—Leather belting (schedule 1883), bolts and nuts (schedule 1885), twist drills, brass wood screws, machine screws (schedule 1881), screw wrenches (schedule 1878), pipe fittings (schedule 1884), bar steel (schedule 1885), rod rivet steel (schedule 1882); November 30—Wood trimmers (schedule 1869); January 11—Ammunition hoist, motor and equipments (schedule 1866).

New Incorporations

Charlerol Automobile Company, Charlerol, Penn. Manufacture automobiles. President, Charles S. Van Voorhis.

Murbola Hosiery Mill Company, Burlington, N. C. Capital, $50,000. Incorporators, E. H. Murray, J. W. Boland, etc.

Polar Ice and Storage Company, Decatur, Ill. Manufacture ice. Capital, $100,000. Incorporators, R. C. Augustine, J. L. Bennett, F. C. Gillham.

Colt-Stratton Company, Inc., New York. Manufacture motors, engines, machines, etc. Capital, $125,000. Incorporators, W. L. Colt, H. L. Stratton, S. H. Veal.

Rodman Hydraulic Valve Company, Kittery, Me. Manufacture and deal in valves, engines, machinery, etc. Capital, $75,000. Geo. E. Burnham, Kittery, president.

Royal Washer Company, Newark, N. J. Manufacture washing machines. Capital, $125,000. Incorporators, J. L. Brownley, A. L. Boylan, J. A. Connolly.

Dahl Manufacturing Company, New York. Manufacture sheet-metal shelves, etc. Capital, $50,000. Incorporators, Albert Dahl, Wm. Schafer, L. T. Valentine.

McDowell Foundry Company, Chicago Heights, Ill. Manufacture metal castings. Capital, $35,000. Incorporators, Irvin McDowell, R. W. Richards, James Stillwell.

Garis-Cochrane Manufacturing Company, Chicago, Ill. Manufacture dishwashing machines. Capital, $100,000. Incorporators, H. S. Osborne, H. A. Berger, J. C. Burchard.

Lewell Manufacturing Company, Chicago, Ill. Manufacture, design and sell machinery. Capital, $30,000. Incorporators, G. E. Chamberlain, C. E. Gilman, A. J. Ehrenberger.

Absolute Time Company, Augusta, Me. Manufacture and deal in time measuring, recording and telegraphing devices. Capital, $1,000,000. R. S. Buzzell, Augusta, president.

International Filter Company, Jersey City, N. J. Manufacture filters, etc. Capital, $25,000. Incorporators, C. E. Halsted, E. B. Proudfit, Westfield, N. J.; H. D. Belmer, Jersey City.

Talt Producer Company, Montclair, N. J. Manufacture gas-power engines and gas producers. Capital, $100,000. Incorporators, E. Benjamin, L. M. Takacs, Newark; F. Benjamin, East Orange.

Williams Sealing Corporation, Waterbury, Conn. Manufacture small machinery and patented articles. Capital, $100,000. Incorporators, N. R. Bronson, J. H. Goss, Waterbury; G. A. Williams, Watertown.

Carper Foundry Machine Company, Beckley, W. Va. Manufacture and deal in and repair machinery. Capital, $25,000. Incorporators, A. L. Carper, Wickham, W. Va.; T. H. Wickham, I. C. Prince, Beckly, etc.

Friction Metal Company, New York. Manufacture safety tread appliances, devices and machinery. Capital, $50,000. Incorporators, John N. Williamson, Centreport, L. I.; F. B. Snow, 48 South Oxford street, Brooklyn, etc.

New Catalogs

Oster Manufacturing Company, Cleveland, Ohio. Catalog of pipe threading and nipple machines. Illustrated, 6x9 inches, paper.

Valley City Machine Works, Grand Rapids, Mich. Catalog of grinding and polishing machinery. Illustrated, 16 pages, 5½x7½ inches, paper.

Celfor Tool Company, Buchanan, Mich. Catalog No. 10 describing drills, chucks, reamers, etc. Illustrated, 30 pages, 6x9 inches, paper.

Trill Indicator Company, Corry, Penn. Catalog of steam-engine indicators, reducing wheels, planimeters. Illustrated, 42 pages, 6x9 inches, paper.

Rockwell Furnace Company, 26 Cortlandt street, New York. Catalog of furnaces for heating, forging, welding, etc. Illustrated, 40 pages, 9x12 inches, paper.

The Cantón-Hughes Pump Company, Canton, Ohio. Catalog No. 25 of steam pumps and hydraulic machinery. Illustrated, 118 pages, 6x8½ inches, paper.

Covington Machine Company, Covington, Va. Catalog of punching and shearing machines, boilermakers' tools, rolls, etc. Illustrated, 28 pages, 6x9 inches.

General Electric Company, Schenectady, N. Y. Bulletin No. 4699, illustrating and describing motor-driven air compressors, geared type. Eight pages, 8x10½ inches.

Noble & Westbrook, Hartford, Conn. Catalog describing steel stamps, letters and figures, seals, burning brands, rubber stamps, etc. Illustrated, 32 pages, 3x6 inches, paper.

The J. C. Ulmer Company, Cleveland, Ohio. Bulletin No. 51, describing transits of precision. Illustrated, 26 pages, 6x9 inches. Bulletin No. 52, describing levels of precision. Illustrated, 16 pages, 6x9 inches.

The Bristol Company, Waterbury, Conn. Bulletin No. 112, illustrating and describing recording thermometers for low and atmospheric ranges of temperatures. 4 pages, 8x10½ inches. Bulletin No. 113, illustrating and describing patent steel belt lacing. 8 pages, 8x10½ inches.

The Bristol Company, Waterbury, Conn. Bulletin No. 108, illustrating and describing indicating electric pyrometers for hardening furnaces. Eight pages, 8x10½ inches. Bulletin No. 115, illustrating and describing indicating and recording units of electric pyrometers for annealing furnaces. Eight pages, 8x10½ inches.

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper catalog free. E. G. Smith Columbia, Pa.

Address of Frank Keasby wanted by Mashek Engineering Company, New York.

We solicit your representation. Maxant & Company, 222 So. Canal St., Chicago, Ill.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Gears; we are in position to take contracts for cutting gears on Fellows gear shaper. The Sinclair-Scott Co., Baltimore, Md.

Machines designed; automatic special. Practical working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emery & Co., Newark, N. J.

Have you small, complicated experimental work or tool designing others can't do? Send to Benj. O. Butler, Taunton, Mass.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

Arthur C. Mason, designing engineer, drafting, special machinery developed, inventions perfected; 227 Canal St., New York City.

Metal specialties manufactured, models, dies and special machinery; inventions perfected. Villinger Mfg. Co., Williamsport, Pa.

Lathe and machine work of every description, patterns, gear cutting, screw machine work, iron, brass and aluminum castings. The Sipp Electric & Machine Co., Paterson, N. J.

Wanted—Purchaser for No. 2 Farwell milling machine, Grant hobbing machine and Gisholt tool grinder; all practically new and in A-1 condition. Box 755, AMER. MACHINIST.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Drawings, designs, tests. Specialists in automobile and internal combustion engines; get your invention ready for manufacture; have specialties for manufacturers. Engineering & Designing Co., P. O. Box 506, New York City.

Machinists and engineers blueprint chart of United States Standard pipes and tapping sizes from ¼" to 10" pipe. Price 10 cents per copy postpaid. Liberal discounts to shop agents. Address Charles Kuderer, Woodlawn, Penn.

Agency Wanted—Active, experienced young man having New York office, centrally located, and extensive acquaintance, trade and consumer, desires Eastern agency for tools or specialties; commission and small drawing account; best of references. Box 837, AM. MA.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Mechanical draftsman wishes position; experience on engines and electrical apparatus; also shop experience. Box 813, AM. MACH.

Experienced superintendent, now employed, open for engagement; large experience in manufacturing small or medium interchangeable work; good reliable mechanic with executive ability; thorough experience in modern shop methods. Box 819, AMER. MACH.

Factory manager or superintendent; have had 20 years' experience in the manufacturing of steel, brass or bronze balls, having invented most of the machinery now being used in the country; also 10 years' knowledge in the manufacture of ball and roller bearings, such as annulars, ball, plain and taper roller thrusts, in fact, every kind of bearing up to five feet in diameter; reference; East preferred. Box 811, AMERICAN MACHINIST.

ILLINOIS

Mechanical engineer, factory systematizer and cost accounting; experienced in electrical apparatus, gas engines, machine and tool building; have served both as chief draftsman and superintendent; wide knowledge of practical shop methods; can furnish best of references from men well known in the mechanical world; open for position as superintendent or master mechanic; age 39. Address "Designer," 321 St. John's Court, Chicago.

MASSACHUSETTS

Position as superintendent or general foreman of machine works or electrical manufacturing, by an experienced man. Box 846, AMERICAN MACHINIST.

Wanted—Position as foreman of screw machine department; expert on estimating, speeds and feeds and the best method of production. Box 847, AMERICAN MACHINIST.

Experienced executive, first-class draftsman and designer, and all-round toolmaker, desires position as superintendent or chief draftsman. Box 842, AMERICAN MACHINIST.

Factory superintendent at present engaged, wishes to make a new connection, preferably New England States; technical education as mechanical engineer; 18 years' manufacturing experience on automobiles, guns, sewing machines, special machinery and similar work. Box 798, AMERICAN MACHINIST.

MEXICO

Export engineer, 27; since two years in Mexico as traveling and industrial engineer, formerly in England, Canada and the United States, wants to represent an industrial firm of the United States in Mexico or go to South America as traveling engineer; speaks fluently English, German, Spanish and fairly Portugese, and has good connections among planters, industrial men, and knows thoroughly the country, the customs and business methods, etc.; at present engaged until the first of January; can furnish first-class references; first-class firms are invited to correspond. "Export," Apartado 1210, Mexico, D. F.

MINNESOTA

Mechanical engineer with thorough technical training and as well practical experience; design standard and special machinery and especially large gas engines; accustomed to research and individual work; desires responsible and permanent position; best of references. Address Box 843, AMER. MACHINIST.

NEW JERSEY

Mechanical draftsman wishes position. Address Box 832, AMERICAN MACHINIST.

Technical graduate, with five years' experience on general machinery, printing press and automatic machine design. Box 827, AM. MA.

Mechanical engineer and designer, seven years' practical experience in drafting room and shop; wants position offering a future; good references. "H. L.," Box 831, AM. MA.

Superintendent, now employed, wants to change; adding machines, typewriters, firearms, electrical instruments, or a similar line of manufacturing of small or medium interchangeable work; broad experience as foreman and superintendent. Box 825, AMER. MACH.

Salesman—Machine tool salesman as sales manager, having 15 years' experience, both in the manufacture and selling of machine tools; competent judge of condition and value of second-hand, and familiar with all makes in the United States; can give best of reference. Box 790, AMERICAN MACHINIST.

NEW YORK

Draftsman, young man (28), desires position in New York; has had five years' experience on engines and boilers. Box 845, AM. M.

Brown & Sharpe automatic screw machine operator can cam up set jobs, wishes position; Brooklyn or New York preferred. Box 839, AMERICAN MACHINIST.

Assistant superintendent and mechanical engineer; machine tools, stamping and forming dies specialty; eleven years' shop, drafting room and office experience. Box 835, AM. MA.

Tool draftsman, Swede, age 27, eight years' experience in special machinery and tools for typewriters and sewing machines, wishes responsible position; references. Address Box 849, AMERICAN MACHINIST.

Specialist on crude oil engines of highest known economy, desires position of full responsibility, in which reliable designs and modern production and sales engineering can help earning dividends. Box 840, AM. MACH.

Wanted—Position as assistant superintendent or chief draftsman; American; 31; technical training; practical and executive experience; A-1 designer, familiar with modern manufacturing methods, pattern and foundry work. Box 838, AMERICAN, MACHINIST.

General superintendent of wide experience in machine shop practice, machine tool designing and automobile construction, seeks change from present connection, preferably in Eastern States; would be glad to hear from any large manufacturing establishment in need of a superintendent with proven executive ability and highest references. Address "C. E. C.," AMERICAN MACHINIST.

OREGON

Master mechanic; responsible, live man experienced in construction and manufacturing in the States, Canada and South America; age 39. B. Nilius, St. Johns, Oregon.

PENNSYLVANIA

Designer of experimental work, fine apparatus, automatic machinery, typewriters, adding machines, etc.; graduate mechanical engineer; 12 years' experience; age 32; will consider position in charge experimenting, developing new machinery, or as chief draftsman, engineer, etc. Address Box 848, AM. M.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted—Experienced mechanical draftsmen for detail work, in a concern manufacturing general rolling mill and hydraulic machinery; state age, experience and salary expected. Box 796, AMERICAN MACHINIST.

Wanted—One hundred first-class machinists; give age, experience, complete references, salary expected; nine-hour city; ideal labor conditions; "trouble" unheard of; living costs low. Apply Bridgeport Manufacturers' Association, Bridgeport, Conn.

Wanted—In a large New England manufacturing plant, an experienced millwright and carpenter, familiar with heavy work, to act as foreman of carpenter's shop (about twelve carpenters) and to take charge of all repairs and the erection of new buildings and machinery. Address "F," AMER. MACH.

DISTRICT OF COLUMBIA

Wanted—Draftsmen; mechanical; temporary duty for three months; salary, $1200 to $1400 per annum; Office Chief of Ordnance, Washington, D. C.; complete statement regarding age, education, experience, past rates of pay, and references should be furnished. Address Chief of Ordnance, U. S. Army, Washington, D. C.

ILLINOIS

Wanted—One first-class toolmaker. H. Mueller Mfg. Co., Decatur, Ill.

MASSACHUSETTS

Wanted—First-class draftsmen. Apply Supervisor of Drafting Rooms, General Electric Company, Pittsfield, Mass.

Wanted—At Leominster, Mass., mechanical draftsman with general experience; state age, nationality, training, previous employment and salary expected. Box 185, Leominster, Mass.

Wanted—Capable executive to take charge of rate setters in engine works; must be experienced in determining piece rates, both directly and indirectly, from analytical time study observations; state age, experience and pay expected; correspondence confidential. Address "R. S. D.," P. O. Box 167, Boston, Mass.

Rate Setters Wanted—Must have had experience with time study method, using shop watches; opportunities for advancement in Massachusetts plant building engines, marine specialties, etc.; state age, experience and salary expected. "R. S.," 24, Box 167, Boston, Mass.

MICHIGAN

Wanted at once, toolmakers, die sinkers, trimming diemakers, machinists, automatic screw machine hands; state age, experience, customary wages and references. Buick Motor Company, Flint, Mich.

Wanted—An expert screw-machine operator to take the position of assistant foreman in a department of about fifty machines consisting of Jones & Lamson's, Acme automatic, Gridley and Cleveland automatic. Box 775, AMERICAN MACHINIST.

MISSOURI

Wanted — High-grade experienced emery wheel salesman to sell carborundum. W. R. Colcord Machinery Co., St. Louis, Mo.

NEW JERSEY

Tool draftsman wanted; must be man well up on tools for small duplicate work; state experience and wages expected; also age and references. Box 808, AMERICAN MACHINIST.

Operator for Gisholt tool grinder, who understands the proper grinding of lathe, planer and boring mill tools; salary, $2.75 for 9-hour day to start; open shop; New Jersey; 50 miles from New York. "M. B. T.," AMERICAN MACHINIST.

Foreman wanted to take charge of an erecting gang of 30 to 40 men; must have had experience as foreman on erecting machine tools and must furnish references; no one but a man of experience and a hustler need apply. Gang boss wanted to take charge of 10 or 12 lathes; must be a first-class lathe and screw machine man with A-1 references and used to handling men and high speeds. In replying, state experience and wages expected. Ferracute Machine Co., Bridgeton, N. J.

NEW YORK

Wanted—An all-round machinist to keep machinery in repair; good pay; must be high-school graduate. Box 844, AMER. MACH.

Wanted—Draftsman familiar with design and construction of steam hammers. Write giving references and stating salary expected. Box 784, AMERICAN MACHINIST.

Wanted—A grinder hand accustomed to sharpening cutters, reamers, etc.; none but a first-class man need apply; give experience, references and wages expected. Otis Elevator Company, Yonkers, N. Y.

Wanted—A thoroughly competent web printing press draftsman; man of experience and ability can have permanent position at high salary; communications confidential. "W. W. C.," AMERICAN MACHINIST.

OHIO

A gas-engine salesman; mechanical engineer to take charge of office. Box 841, AM. MACH.

Wanted—Manager who can obtain some capital, for modern machine works, running day and night, located in Ohio. "Engineers," Box 759, AMERICAN MACHINIST.

Wanted—First-class large lathe and planer operators; good wages and steady work for the right parties; location, medium size town in central part of Ohio. Box 834, AM. MACH.

Wanted—Several first-class draftsmen thoroughly familiar with designing steam hammers. In applying state age, experience and salary desired. Box 791, AMER. MACHINIST.

Wanted—A high-class, experienced foreman for sheet and steel department of a large stove foundry, desired from January 1 next; give references, experience and wages desired. Address "Morning Star," AM. MACH.

Superintendent; progressive manufacturer, having foundry, pattern and machine shops employing 500 men, needs a thoroughly experienced and systematic superintendent; machine shop and foundry experience essential; give full details, past and present record, naming employers; communications strictly confidential; only men with a record need apply. Box 688, AMERICAN MACHINIST.

Wanted — First-class machinists, lathe, planer, brass molders, drill press, screw machine boring and milling machine operators, die sinkers and patternmakers who are seeking positions or desirous of improving on those which they have, to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address Commissioner's Office, 605 New England Building, Cleveland, O.

PENNSYLVANIA

Wanted—First-class draftsman, familiar with engine and boiler layouts and designing; steady employment. Address P. O. Box 512, Erie, Penn.

Wanted—Assistant foreman, machining department; factory making mechanics tools; promotion; state wages, age, experience. "X. Y. Z., AMERICAN MACHINIST.

Wanted—A mechanical draftsman; one having had a miscellaneous experience and capable of following up a scheme from its conception to a successful conclusion. Box 833, AMERICAN MACHINIST.

Draftsman; young man thoroughly experienced in designing dies for stamping and sheet metal work at a small, but growing corporation in Philadelphia; give age, experience, reference and salary expected. Box Thirty, 3327 North 21st Street, Philadelphia, Pa.

Wanted—A good live agent in every shop or factory in the U. S. to sell one of the best known preparations for removing grease and grime from the hands without injury to the skin. Absolutely guaranteed. An agent can make from $5.00 to $25.00 over and above his regular salary. This is no fake. Write for free sample and agents' terms. The Klenzola Co., Erie, Pa.

For Sale

For Sale—Machine shop and foundry well equipped, successfully running under lease in best town in eastern Oregon; a rare bargain; $6000 cash, balance time. Box 836, AM. M.

For Sale—Or will exchange for machinery or automobile, patent right and complete set of patterns and drawings for the Corbin computing scale; the simplest and best balancing computing scale on the market; cash price $700. Address C. Corbin, Silvis, Ill.

For Sale—Modern new steel brick lined shop and tools, four years in operation; new tools, electric crane, gas engine and motor drive; running day and night since January; owners will retain part interest and give management to right party; located in Central West. Box 760, AMERICAN MACHINIST.

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Building a Ball-bearing Typewriter

Some of the Unusual Operations Such As Turning Ball Races in a Curved Bar, Automatic Turning, Drilling and Tapping Machines

EDITORIAL CORRESPONDENCE

The building of a modern typewriter involves many operations which are enough out of the ordinary to be intensely interesting and, with the introduction of visible machines as well as ball bearings on the type bars, these operations have taken on an added interest.

While the operations shown are not by any means all that are unusual, we have, with the kindly assistance of works manager John H. Barr, and the engineering manager, A. J. Briggs, selected some which show a line of interesting problems that have been encountered and solved. Some of these were brought out in connection with their older type of machine, but perhaps the most interesting mechanisms are to be found in the making of their newer type, the Smith-Premier No. 10, which is a visible-writing machine with a complete bank of keys, 84 in number, each type bar mounted on a ball bearing of 3/32-inch balls and adjusted by two threaded cones as in larger work. This is, we believe, the only visible writing machine with a full keyboard, which adds much to the difficulty of design and construction.

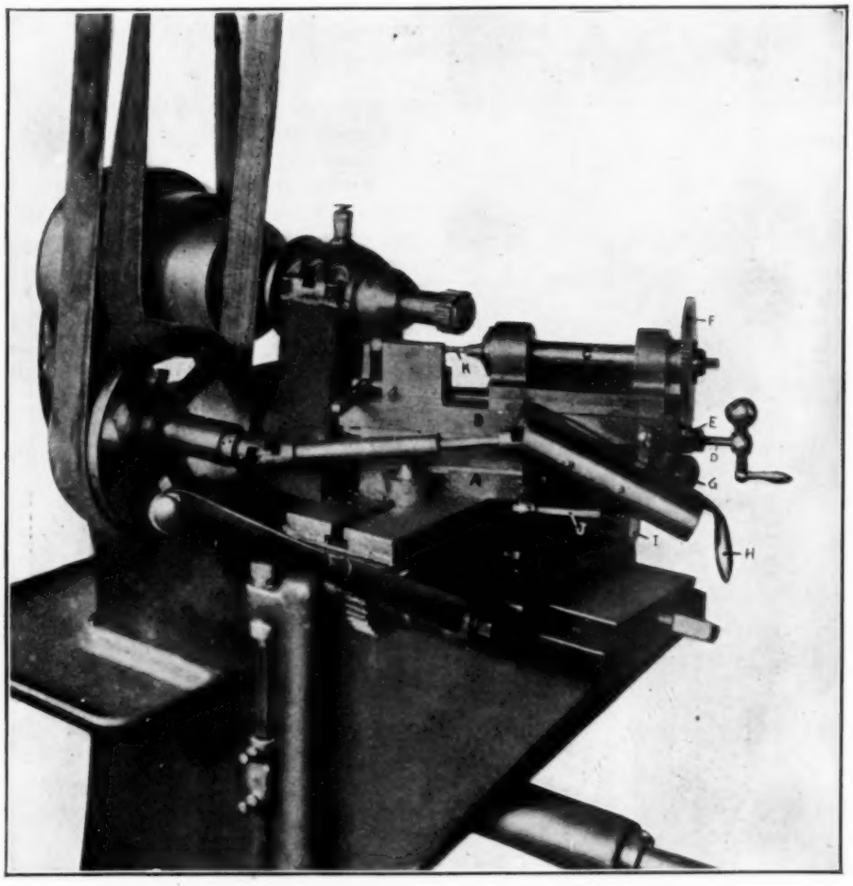


FIG. 1. HOBBING 7-TOOTH RATCHETS

Milling Spiral Ratchet Wheels

The fixture shown in Fig. 1 was built to cut the spiral teeth on the end of the sleeve shown in Fig. 2, and has proved to be a satisfactory and cheap method of doing this work. This ratchet-toothed spiral has seven teeth cut at an angle of about 60 degrees with the axis; the outside diameter is 9/16 and the face is ¼ inch.

The fixture consists of a base casting *A* bolted to the table of the milling machine with a slide *B* gibbed to it at the angle of the teeth with the axis. On this are mounted the spindle *C* and the sliding pin *K* for driving and supporting the work. The table is fed forward by the lead screw *D*, which is geared up to spindle *C*, with such a ratio as to cause the spindle to make one complete revolution while the table is advancing the amount of the lead of the spiral being cut.

Power feed is obtained by lifting worm *G* into mesh with worm wheel on lead screw. The worm is mounted on a horizontal shaft having bearings in a U-shaped casting pivoted to the sides of slide *B*, while *I* is a latch to hold the worm in mesh when the frame is lifted by the handle *H*. The knockout pin *J* allows the worm to drop out of mesh when the cut is completed. The worm is driven by a pair of bevel gears through the universal shaft and pulley mounted on a bracket at the side of the machine. The cutter is made

FIG. 2

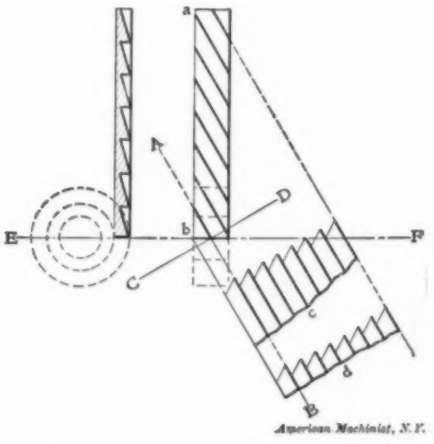


FIG. 3. CUTTING THE RATCHET

up of eight thin formed cutters having the correct shape of the cut necessary to form the teeth.

The principle of operation is best explained by considering a thin section of the surface of the spiral containing the teeth as unwrapped from the sleeve and spread out on a flat surface, as shown in diagram, Fig. 3. It is obvious that if a cutter having teeth of the shape shown at *c* were passed over the flat piece *a b*, in the direction *A B*, the teeth would be produced. Now let us imagine *a b* bent back around the hub as indicated by dotted lines, the point *b* remaining stationary. The cutter will still fit the teeth at the point of intersection of *A B* and *C D*, and

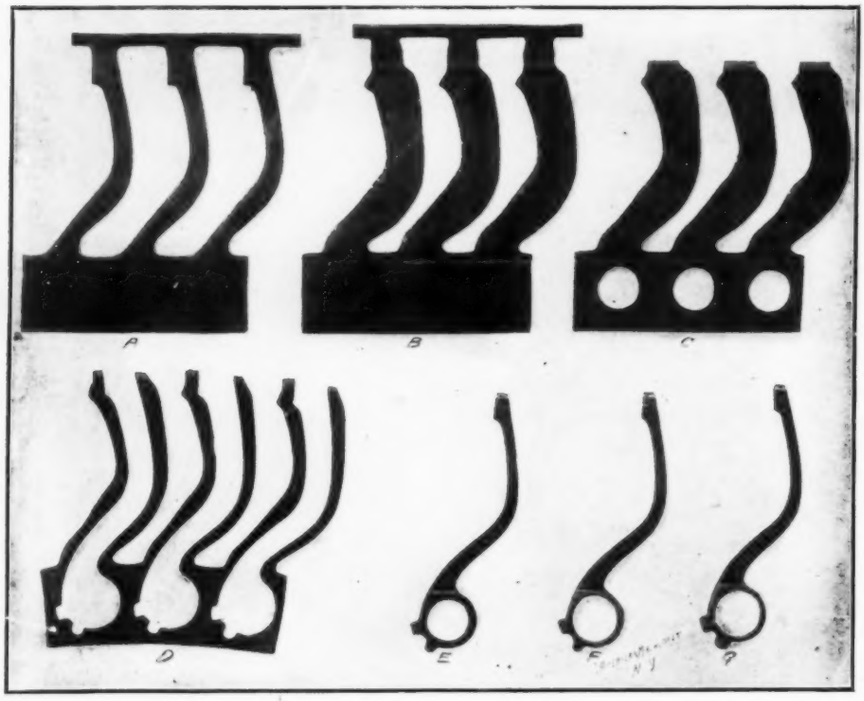


FIG. 4. EVOLUTION OF THE BALL-BEARING TYPE BAR

will practically fit along the line *C D* on a spiral with narrow face and moderate lead. If we consider the cutter running with its axis directly over the line *C D* the spiral could be revolved in such a way that the teeth would be cut in the same way as on the flat strip. This motion is produced by revolving the blank about its axis one turn and advancing it in the direction *E F* the amount of the lead of the spiral to be cut. Only one tooth of the cutter can pass over the point of intersection of *C D* and *E F*. In order to compensate for this condition it is necessary to make the face of the cutter concave, as shown at *d*. The angle of each tooth must also be modified so as to fit where the cutting point does not come at the intersection of the two axes.

New Model Ball-bearing Type Bar

Some of the processes through which the ball-bearing type bar passes in its evolution from the sheet material to completion ready for the insertion of the ball bearings are indicated in Fig. 4. In making this bar, sheet metal about 0.110 inch in thickness is run through the punch press where openings between the arms are punched and the piece cut off, as indicated at *A*, the piece as cut being long enough for three bars. This blank has three arms left after the punching operation in which there is sufficient stock for the forming of the three type bars. From the punch press the work goes to the drop hammer, where the arms are struck taper and considerably thinner than the stock,

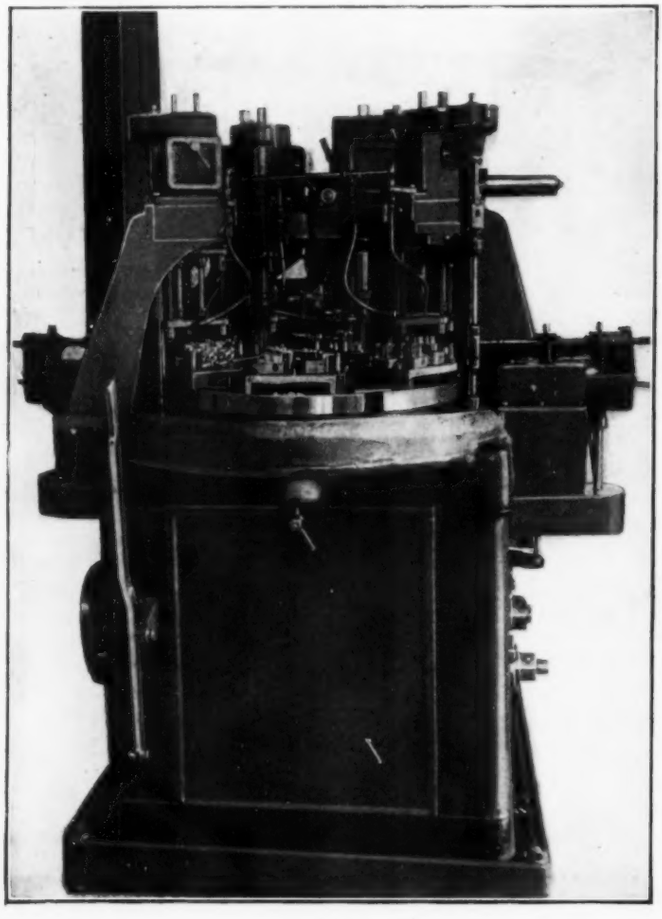


FIG. 5

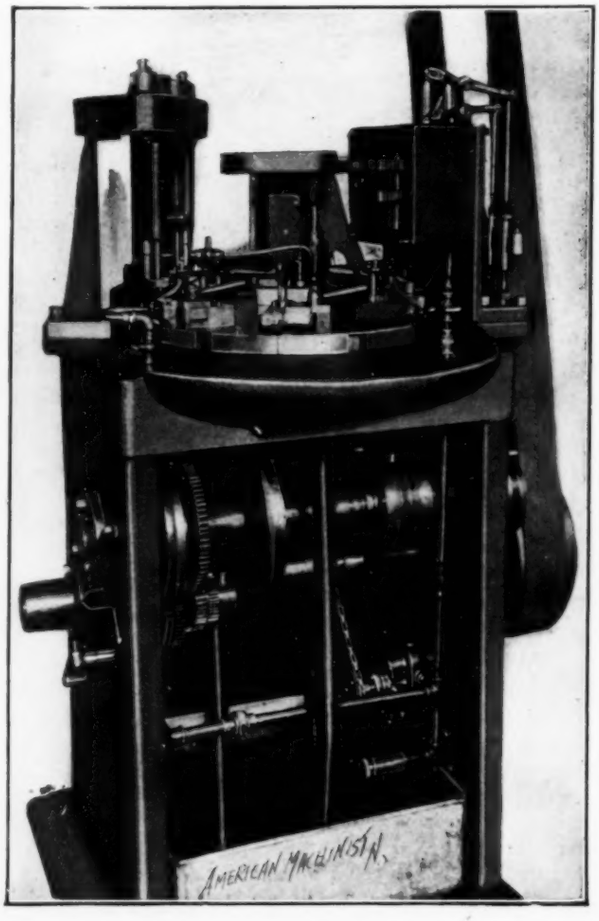


FIG. 6

MACHINES FOR PERFORMING DRILLING, REAMING, TAPPING AND OTHER OPERATIONS ON TYPE BARS

FIG. 9. ROLLING ANGLE PLATES

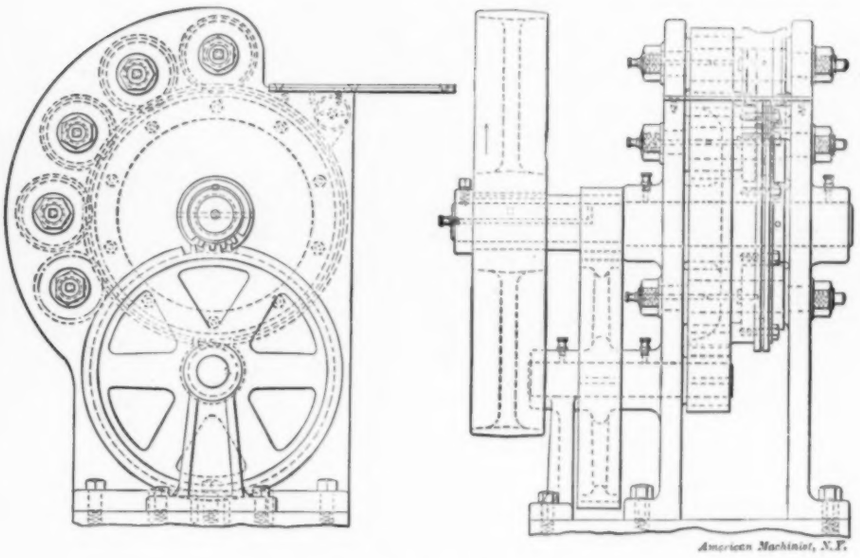


FIG. 10. DETAILS OF ANGLE-PLATE ROLLING MACHINE

as shown at *B*. In the next operation the connecting rib at the tops of the arms is sheared off and three holes punched in the base as at *C*. The next operation in the punch press blanks out the individual arms, the scrap left being shown at *D* and one of the blank arms at *E*.

Special machines are then used for drilling and tapping the holes to receive the ball cups, drilling and reaming the hole at the small end for the reception of the type itself and the hole for the link by which the bar is operated at *F*. In the next operation the large end of the bar is slotted crosswise as at *G*, the ear for operating rivet is slotted, and the clamping screw hole is drilled and tapped, thus completing the operation not shown at *F*. The clamping screw used in the split-ring end thus formed enables the ball cups to be securely clamped after they are properly adjusted. This process makes a strong, light and graceful bar, the material being a particularly stiff and yet tough alloy steel.

The clamping screw for holding the ball cones deserves special mention as, in spite of its small size, a No. 1-72 screw, it is practically unbreakable by even the huskiest repair man and his screwdriver. It is made of a nickel vanadium steel and is astonishingly strong.

The special machines just referred to are shown in Figs. 5 and 6. They have indexing work tables with special fixtures for holding the type bars while a series of spindles bring the different drills, taps, etc., into operation as the work is indexed around to the successive positions.

Drilling Attachment on Automatic Screw Machine

Fig. 7 shows a very interesting attachment to a Brown & Sharpe automatic screw machine for drilling eight small

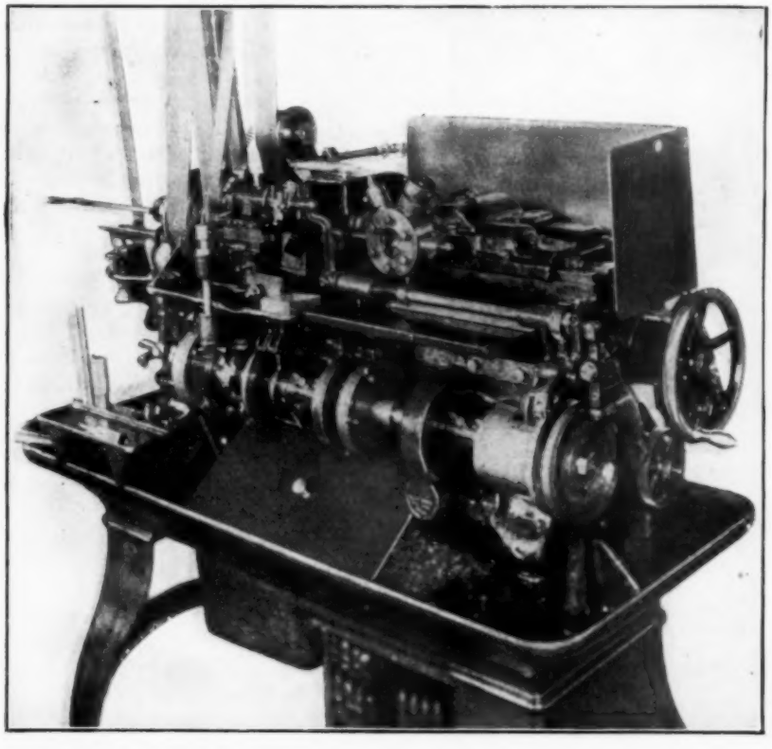


FIG. 7. DRILLING ATTACHMENT FOR AUTOMATIC SCREW MACHINE

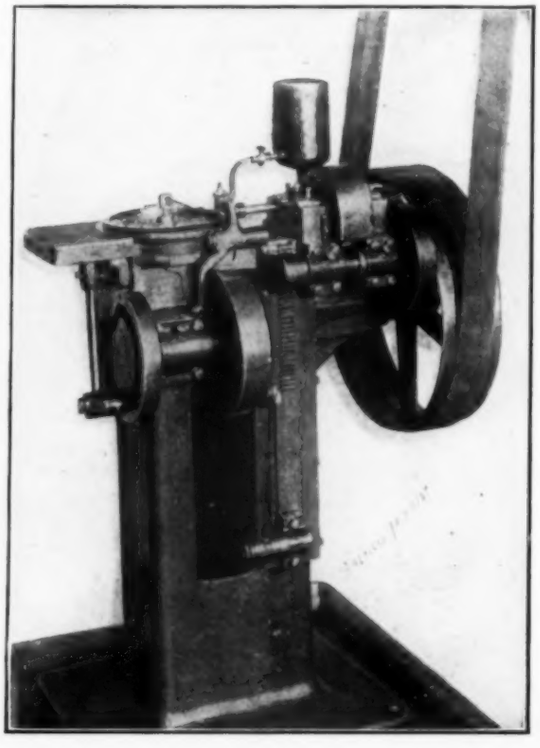


FIG. 8. AUTOMATIC TAPPING MACHINE

holes 0.048 inch in diameter, in the ball-bearing cones which go in each type bar. These cones are 21/32 inch outside and 3/8 inch inside measurement and have a fine thread on the outside for screwing into the type bars to retain the balls.

The screw machine drills, forms, threads and starts to cut off the first piece before the attachment comes into play, but before it is cut off the carrier arm shown on the rod in front of the machine, drops down and inserts a pin in the hole of the cone being cut off. As soon as the cutting off is done, the arm comes up into the position shown and inserts the cone in the jig while the double-spindle drill gets busy on the other side, drilling two holes at a time.

These drills go in to the desired depth; being adjusting holes they do not go clear through the cone. Then the two drill spindles are indexed around and with four positions, drill the 8 holes.

All this must be done while the screw machine is doing its work on the cone, so that everything must be timed to bring the carrying arm down at the right moment to pick up the piece being cut off; and as the drilling is done during the same period, this operation costs nothing in time, the cost being entirely in the making of the attachment and keeping it in order. The total time of the operation is 22 seconds.

Automatic Tapping Machine

The clevis which goes on the end of the rod connecting the key and the type-bar mechanism is formed from sheet metal in a compound die, coming in a continuous stream from the strip of metal. They are then tapped in the machine shown in Fig. 8, being held in the horizontal disk at the top. They are loaded from the front and when they come into tapping position are held by the arm which comes down on top of them.

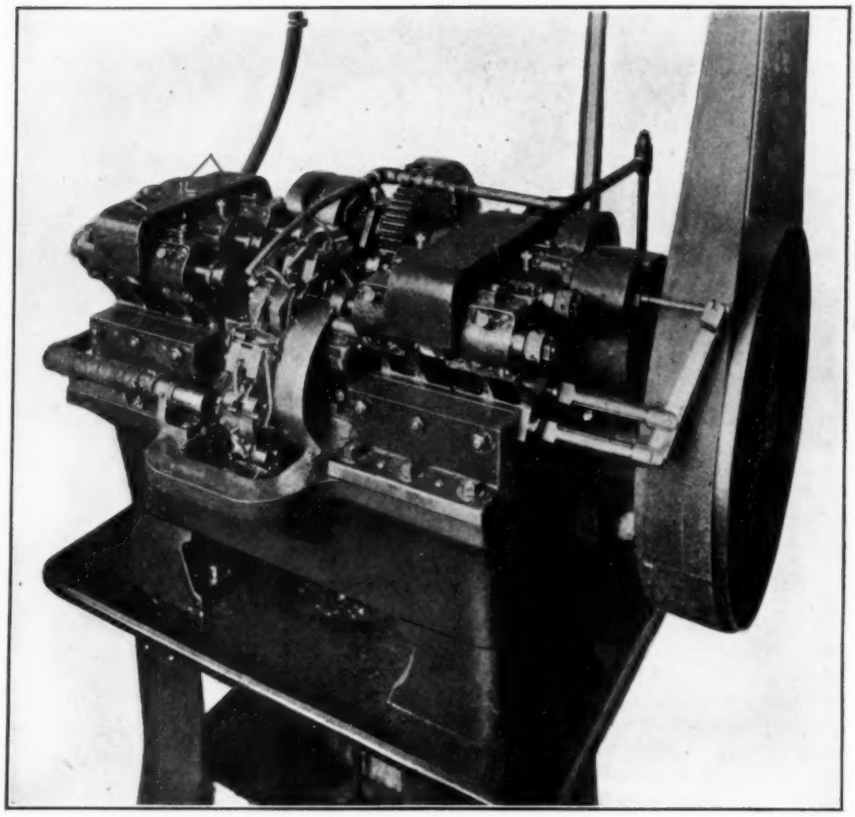


FIG. 12. AUTOMATIC DRILLING MACHINE FOR TYPE BARS

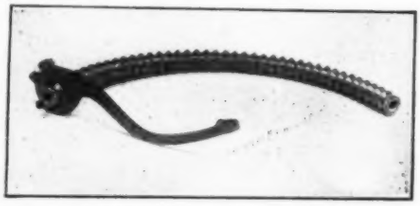


FIG. 13. THE CURVED HANGER BAR

It is all driven from the single belt at the right, the tapping spindle being connected by gearing and reversing automatically when the tap has made a predetermined number of revolutions in the forward motion. The indexing cam is clearly shown and the work, after being tapped, is automatically thrown out of the holder by the inclined rod at the back. This makes it only necessary to load the machine so that it can be handled at a very rapid rate.

Making Curved Angle Pieces

Among the essential parts of the machine is a pair of curved bars of right-angle section and these are made from flat strips which are first rolled into a channel section and then cut down the center so as to give the angles; at the same time they are curved to the right radius.

The machine for doing this is shown in Fig. 9 and consists for the most part of a frame and a set of gear-driven rolls, part of which can be seen between the plates. The strips are started between the guiding plates shown just over the driving pulley and go under the forming rolls which roll down the edges against a large roll in the center. This large roll is grooved in the center and the last roll of the train fits into this groove and acts as a cutting tool, splitting the channel into two angle pieces

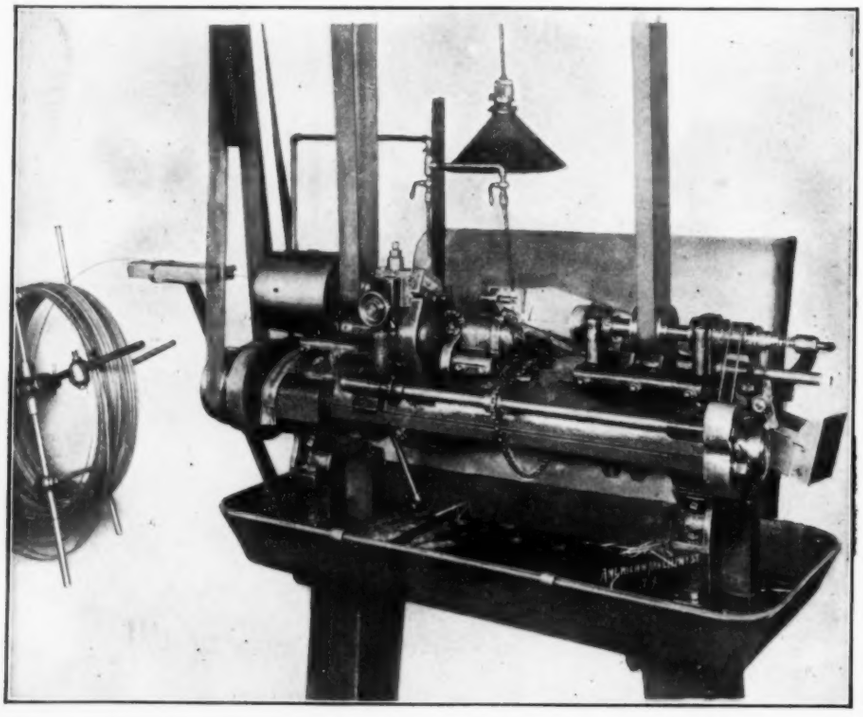


FIG. 11. MAKING OLD-STYLE TYPE BARS ON AUTOMATIC LATHE

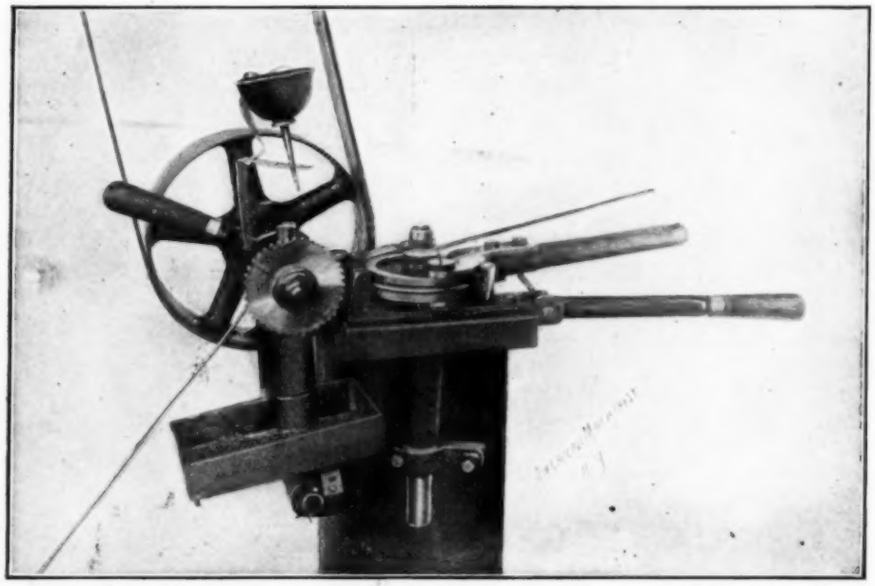


FIG. 14. BENDING THE TYPE BAR HANGER

already curved to the radius wanted. Detail of this machine is shown in Fig. 10.

Making the Understroke Type Bars

These bars are round in section, tapering from the shank toward the head, which is also round and of the same size as the shank. The machine shown in Fig. 11 takes wire from the reel through the oiling clamp and into the straightener, thence through the head where it is cut off to the right length and the forward end gripped by the chuck on the right-hand spindle which moves forward at the proper time for that purpose.

Driving the rods from this end they are turned by the single-pointed tool shown in the cross slide, this cross slide being controlled by a cam which feeds it in to give the required taper and then out when the head end is reached.

It is entirely automatic, delivering the finished piece ready to forge into the trough at the back.

Type-bar Drilling Machine for Understroke Models

These type bars have a long bearing, as can be seen from the two bars lying on the machine, Fig. 12. The bars are held in the clamps on the revolving disk in the

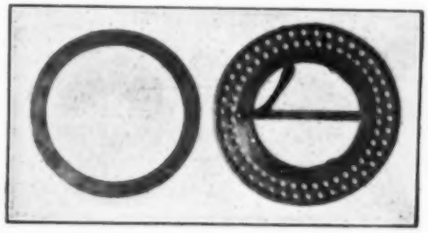


FIG. 17. A 91-HOLE RING AND THE PUNCHING GUIDE USED

center of the machine. The operator places the bar in the position showing it held loosely, the jaws being closed by a cam as it passes to the first drilling position where it is drilled on each end. The next position countersinks the end at the right and drills a hole in the small puller or operating arm at the other end, while the third countersinks the puller arm from both sides, the long reach being secured by the arm outside the pulley at the right.

When the drilled type bar gets around to the lower position in front, the jaws open for the removal of the finished piece and the compressed air in the pipe at the left blows the chips out so the next piece is sure to be correctly centered for drilling.

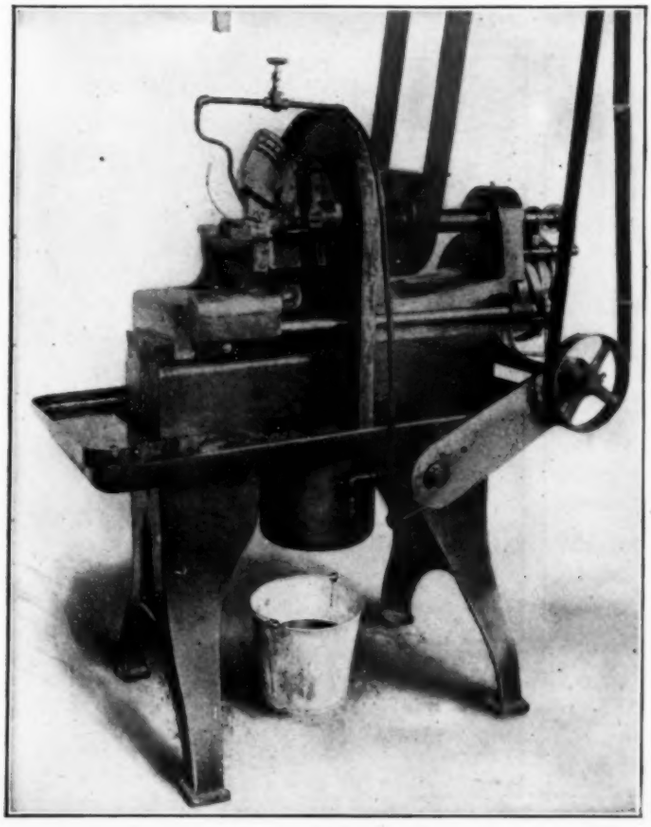


FIG. 15. TURNING BALL RACES ON A CURVED BAR

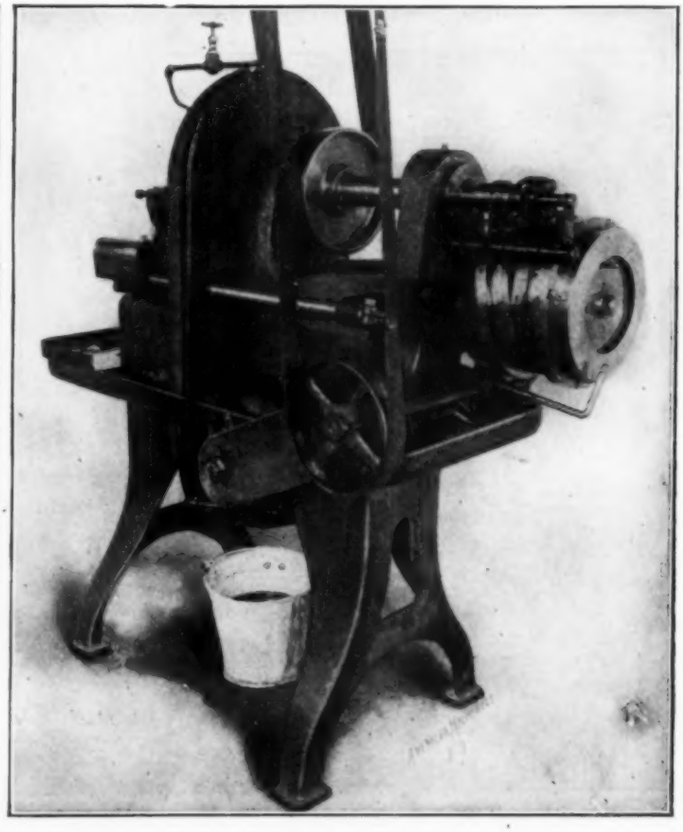


FIG. 16. REAR VIEW SHOWING CAMS

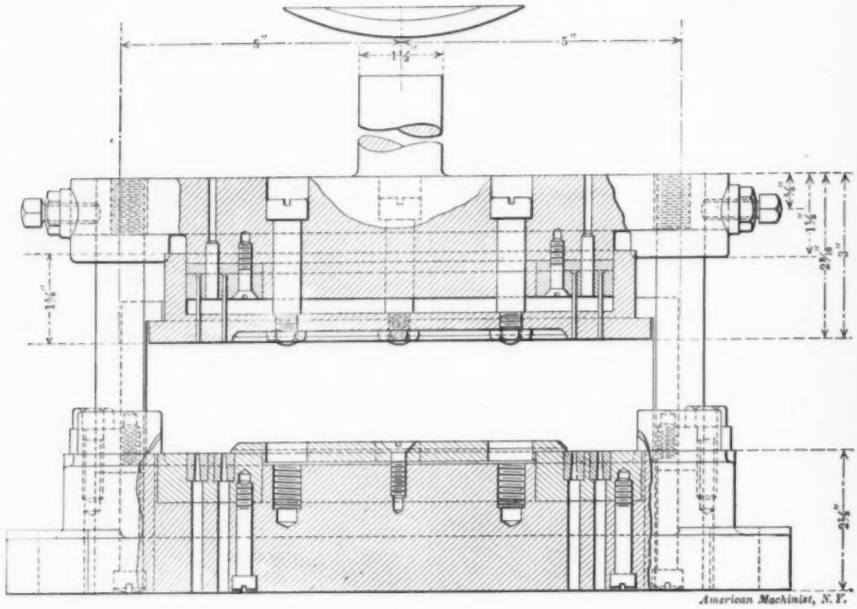


FIG. 18. DETAILS OF SUB-PRESS DIE

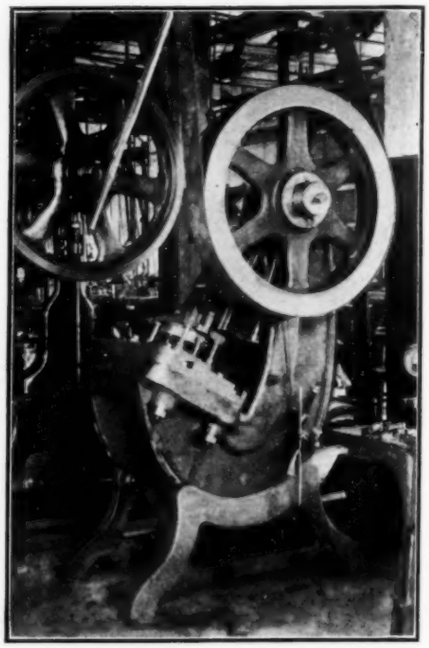


FIG. 19. SUB-PRESS DIE PUNCHING 91 HOLES

TURNING A CURVED BAR

The making of the type-bar hanger ring presents some very interesting features on account of the bar being curved to a true radius and forming the inner bearing or ball races for the ball-bearing type bars. This prevents the grooves or races being turned in the straight bar and then curving the bar, as the races must be perfect grooves, each radial from the center of the arc to which the ring is curved. A bar with one type bar in place is shown in Fig. 13.

The bars are first curved in the machine shown in Fig. 14 and then cut off by the saw. A notch is also cut in the end so that the curved bar can be moved positively into the various positions.

The curved bars then go to the turning machines shown in Figs. 15 and 16. The bar is clamped against the angle plate, the notch already referred to being engaged by the indexing arrangement, and the bar set to bring the turning tools in position for the first groove. When this is turned, the chuck is indexed automatically so as to bring the bar into position for the next groove and so on until the bar is completed. The indexing is controlled by the cams at the end of the machine much as in screw-machine work. The appearance of the machine at work is somewhat start-

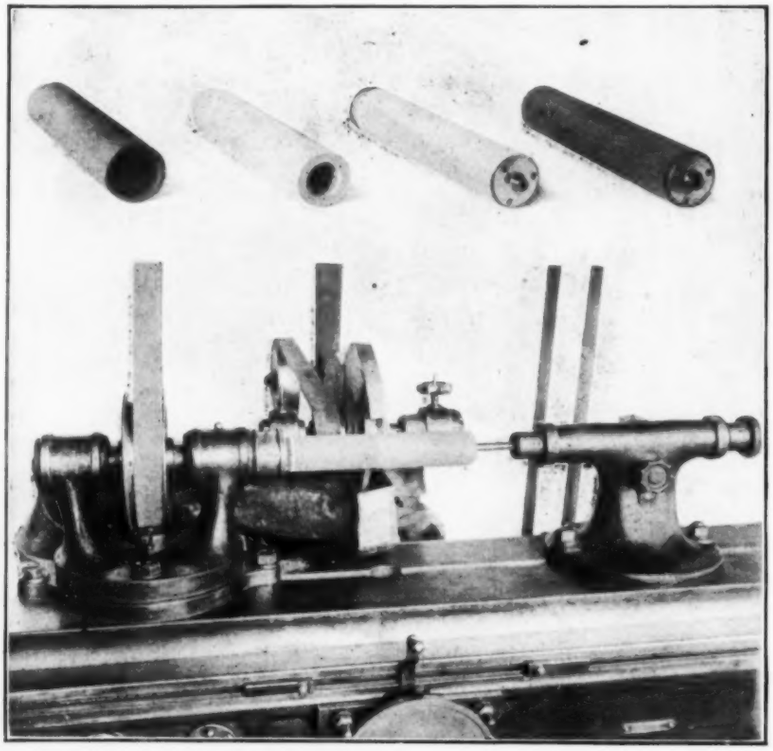


FIG. 20. PLATEN ROLLS IN VARIOUS STAGES
FIG. 21. GRINDING THE RUBBER PLATEN ROLLS

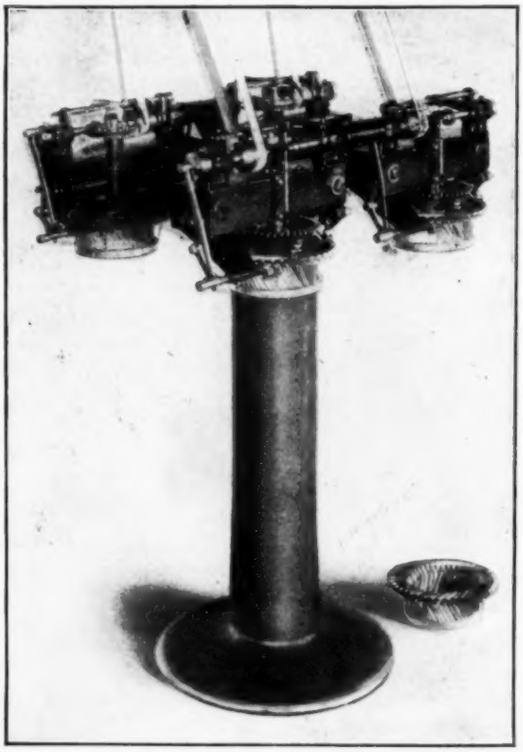


FIG. 22. EXERCISING TYPE-BAR MOTIONS OR BASKETS

ling, as we are not accustomed to seeing work being turned with one end waving wildly in the air, and the shop name of "pig tail" machine is not so far from describing its appearance as might be imagined.

One end of the bar is left longer than necessary, for chucking purposes, and is afterward cut off and the ends ground to bring them exactly to gage. Two sizes of these bars are made, one for each set of type bars, and they are of different radius so that they are turned on separate machines.

The setting of the work to the new position is accomplished by the cams acting on the controlling lock and ratchet through the telescoping rod and spindle at the end of the spindle. The rod in the center, controlled by the arm at the end, loosens the clamp or chuck when another cam operates the telescoping tube and indexes the work one notch on the angle

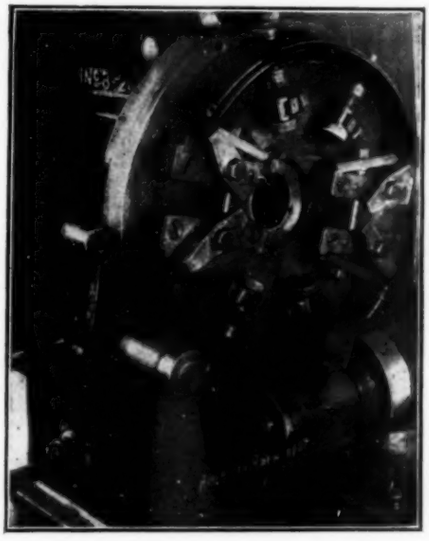


FIG. 23. MILLING SLOTS IN A CURVED GUIDE

plate. The cross movement of the slides is accomplished by the rod alongside the machine, being acted on through the lever, by a cam on the large gear.

A Sub-press Die with 91 Punches

In Fig. 17 is seen a ring which has 91 holes, most of them about 1/16 inch and the rest 3/32 inch in diameter. Beside it is the punching or index plate which was formerly used in punching these, the plate to be punched being held in the index plate, which was located by a small conical die. By this means the holes were punched one at a time under a press.

This has been supplanted by a sub-press die as shown in detail in Fig. 18 and in place on the press in Fig. 19. The construction of the die requires very little explanation, the die plate being a separate ring from the base plate and carrying hardened bushings, while the punches are mounted in a ring above and supported to the surface of the plate by the circular stripper which is fastened in front of the punch plate proper. It makes a rather complicated punch to build but does at one stroke what formerly took 91 separate operations.

The Rubber Platen Rolls

The construction of the platen rolls is shown in Fig. 20, *A* being the rubber tube, *B* the wooden roll over which it is drawn, *C* the roll with the mountings in the ends and *D* the completed roll. These are then mounted in the grinding machine as in Fig. 21 and ground dry with a carborundum wheel. Two cuts are taken and on a 10-inch roll this requires about two minutes for the complete roll.

Exercising the Type Bars

After the type bars are assembled in baskets as they are called, they go to the exercising machine to be limbered up. One of these machines is shown in Fig. 22, and each machine is fitted up to handle four baskets at once. There are two sets of type bars, one being handled from the front as shown and the other at the back, just being visible on the first basket.

Each exerciser is driven by a separate belt and indexing is done by a differential worm gear at the top, so that after a key has been vibrated 1460 times, the fingers are thrown out of action, the basket indexed to bring the next type bar into position, and the vibrator again starts at work on the next pair of bars.

A Special Milling Machine

This is almost a gear cutter in action, as can be seen in Fig. 23, the work being two curved rings for the type bars, which must be milled with radial slots. Two of these rings are clamped to the faceplate and the machine started, the operation being almost identical with a gear cutter of this type.

After one ring has been cut with the required 84 slots, a cam throws the cutter feed out of commission until the faceplate has turned enough to bring the next ring into position to be cut, when the regular cutting and indexing are resumed. The finished piece can be removed and a new one put into place while the machine is at work, so that the operation is continuous.

Notes Abroad—Building an Aeroplane Motor

By Parisian

I visited a little shop doing big work last week. I mean the Syndicat de moteurs E. N. V.

The shop manager and inventor of the motor is Mr. Rath, late of Charron's, at Puteaux. The E. N. V. shop is situated at Courbevoie just outside Paris and in the direction of Puteaux. There are probably 50 workmen and two designers engaged on the products of this little firm, the principal one being aëroplane motors. Mr. Cody has one, Blériot has one on his new type of machine, and aviators seem to be placing orders.

The specialty of the motor is its cylinder and the "clou" of the cylinder is its water

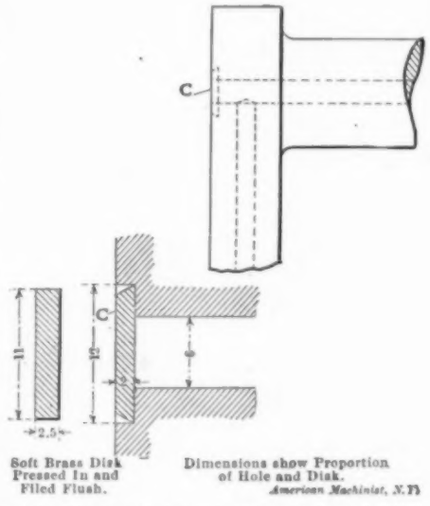
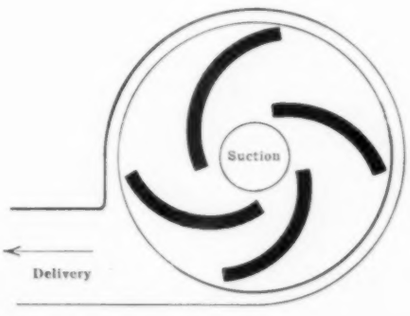


FIG. 1. METHOD OF PLUGGING OIL HOLES IN E. N. V. AËROPLANE ENGINE CRANKSHAFT

jacket. This is not cast with the cylinder in the ordinary way, but is of copper deposited on a wax core by electrolysis to a thickness of about 1 millimeter (0.04 inch). The process is patented.

Naturally I was not shown this process, but I caught sight of several cast-iron molds split in two which seemed to serve



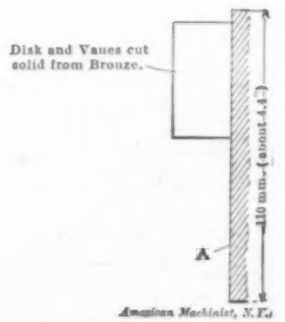


FIG. 2. SCHEME OF CIRCULATING PUMP OF E. N. V. AËROPLANE MOTOR

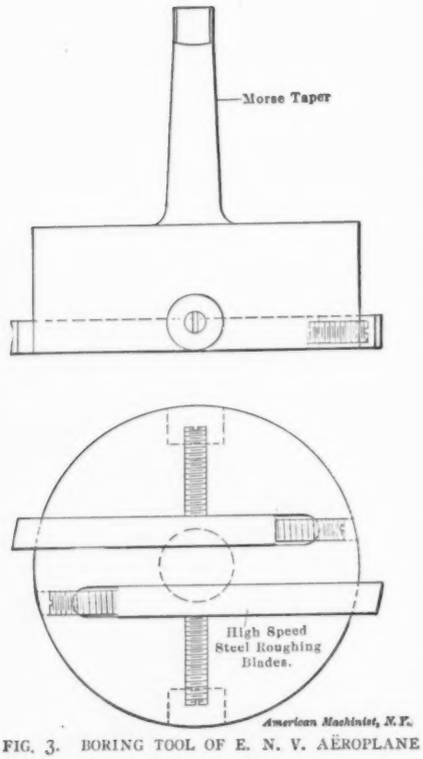


FIG. 3. BORING TOOL OF E. N. V. AËROPLANE MOTOR CYLINDER

either to pour the wax composition into the cylinder or to secure an even coating of copper. Again, I suppose that the "wax" will hold some carbon coating acting as an electrode.

The weight of the reciprocating parts per cylinder is something like 1 kilogram (2.2 pounds). The pistons are of forged steel and the rings cast iron.

The lubrication of this motor, which is, if I remember rightly, about 60 horsepower and consisting of eight cylinders, is by means of the crank shaft which is drilled from end to end. The inevitable holes left open from drilling obliquely, etc., are closed by coning the hole and pressing a brass washer into place by a press, as shown at Fig. 1. The lubricating pump is driven from an eccentric (see Fig. 4), turned solid on the end of the crank shaft, and the oil ascends through the center of the plunger and passes into the crank shaft through several holes drilled around the circumference of the said eccentric part. A simple ball valve traps the oil on the up stroke of the plunger as same is single acting. A system of filtering is used which eliminates most of the chances of any grit getting into the motor. These motors sell for 10,000 francs ($2000).

The circulating pump is exceedingly simple, and is shown diagrammatically at Fig. 2. Care must be taken to have the surface at *A* very clean or the efficiency is decreased.

Mr. Rath uses a boring tool for his cylinders of a very simple nature, as shown at Fig. 3. He is a partisan of the converted column-drill for boring cylinders, but also thinks the cylindrical-grinding method just as good. There is talk of starting a shop in England and in that case I am sure the firm will meet with a warm reception in the aviation world.

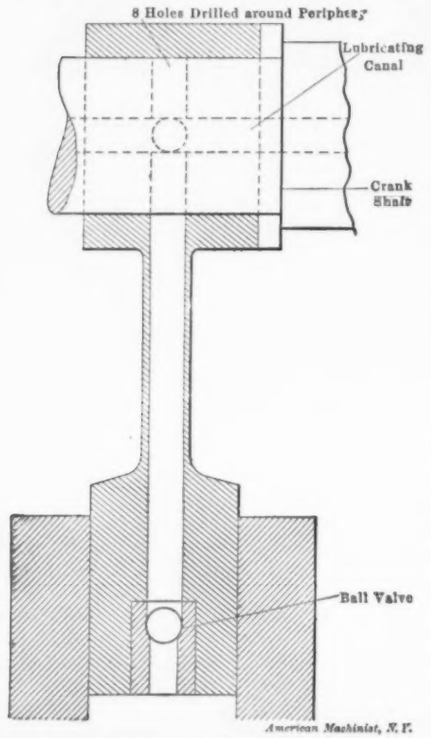


FIG. 4. CRANKSHAFT OILING SYSTEM OF E. N. V. AËROPLANE MOTOR

I visited the Charron shops two years ago when Mr. Rath was tool superintendent there and I remember what a pronounced advocate of form tools he was; doing work at one "go" that would have astonished many English tool men. His maxim was "get the job stiffly supported and you can do anything."

This firm also makes a car with two speeds and a reverse by internal gears in the gear box and the other speeds with the differential box. This, together with the clutch and motor of the E. N. V. type makes a car well out of the ordinary run and correspondingly interesting.

The Influence of Speed on the Cutting Action when Turning

By H. S. Millar

Attention has been called to the fact that speed affects the cutting ability of tools. That tools that had become too blunt to

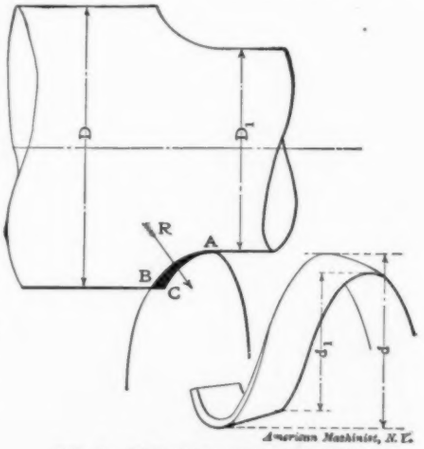


FIG. 1. THE TOOL AND THE CHIP

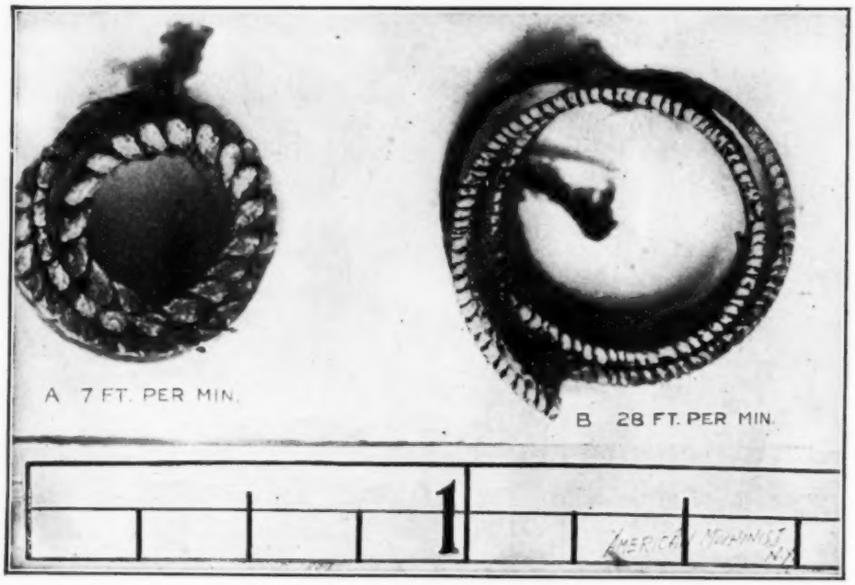


FIG. 2. CHIPS CUT AT DIFFERENT SPEEDS

cut at a slow speed, and which with small cuts simply slid over the metal, regained the ability to cut with an increase of cutting speed. This article is an attempt to give a slight analysis of the cutting action when turning, rather particularly with the lower-carbon steels, and thus to show how speed affects the action.

With the help of a friend a number of cuts were taken in a lathe at speeds varying from 7 to 124 feet per minute. The same tool was used throughout. Afterward some variation was made in the feeds. Photographs of some of the

chips or cuttings taken are here shown to illustrate the condition obtaining during the cut. Some effects of variation in cutting speed have been examined by Doctor Nicolson and the diagram Fig. 6, showing the variation of cutting pressure with speed, was taken from the paper read at the Chicago meeting of Institution of Mechanical Engineers.

Typical Chips

As a preliminary to an analysis of the cutting action it will be advantagous to select a typical chip, say *B*, Figs. 2 and 3. and to consider the forces exerted upon it in its making and which control its shape. The plan shape of the tool and its cutting angle affect the resulting chip. The tests were made with a round-nosed tool. The shape of the tool, cut and chip is shown generally by the sketch Fig. 1, which, however, does not show the true proportions of each. The cutting angle of the tool was kept constant through each set of tests. It is obvious that to produce a chip similar to this from the metal as it originally laid round the bar there must be considerable distortion. The difference in distorted length of the planes of metal represented in plan by lines *A B* and *A C* give rise to a circular or a helical chip. The diameter of the helix is dependent upon the amount of distortion. A helix of small diameter relatively to the thickness of the chip indicates a large amount of distortion and generally speaking the amount of distortion may be discerned by consideration of the chip spiral. The amount of distortion is important in considering the cutting action. It is an indication of the pressure on the tool. Of course, all chips do not come off the tool as helices. The character of the chip in this respect is influenced mainly by the direction of the horizontal resultant force *R* The photographs Figs. 2, 3 and 4 illustrate varying amounts of distortion. They are all of low-carbon steel; *A* and *B*, Figs. 2 and 3, were of the same area and shape of cut and were taken by the same tool; *C*, *D* and *E* were each similar in these respects. The left-hand specimen *A*, Fig. 2, was cut at 7 feet per minute and *B* at 28 feet per minute. Fig. 3 shows the longitudinal view of similar chips. The chips, Fig. 4, were taken at cutting speeds of 45, 75 and 124 feet per minute, respectively. The difference in the diameter of the spiral of the chips *D* and *E* is not marked, and therefore the reason for the greater pitch is not clear.

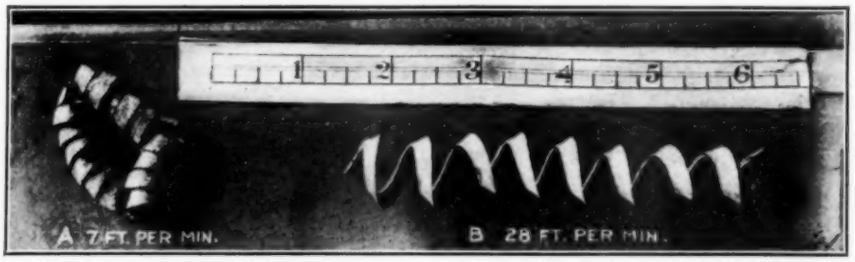


FIG. 3. CHIPS CUT AT DIFFERENT SPEEDS

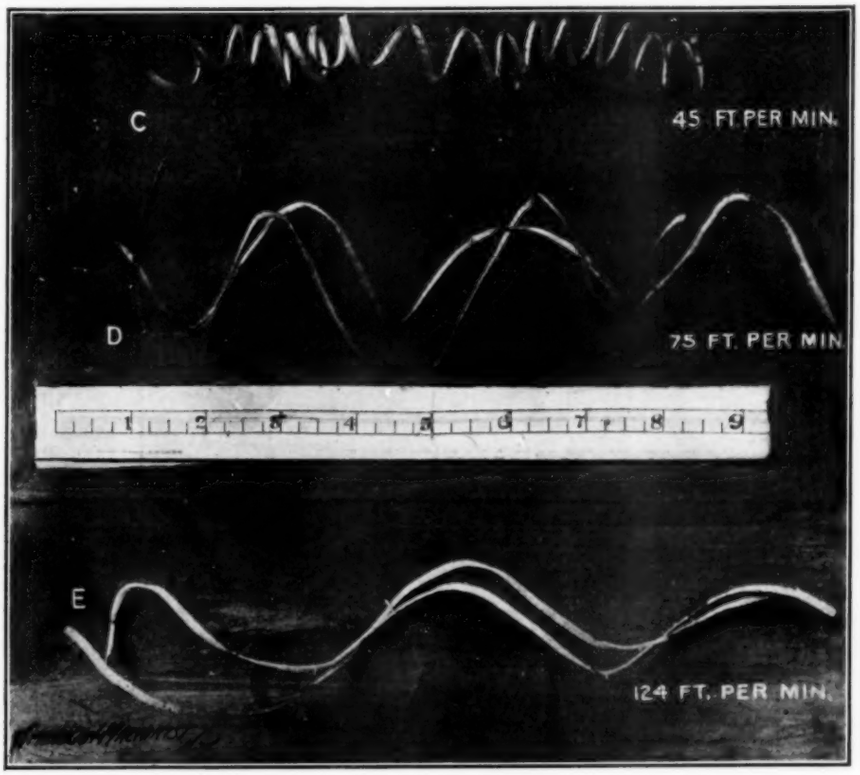


FIG. 4. HELICES OF CHIPS CUT AT DIFFERENT SPEEDS

Cutting at Slow Speeds

Doctor Nicolson's analysis of metal turning at extremely slow speeds is interesting. The tests were made at cutting speeds varying from 1 foot in one hour to 1 foot in 4½ hours. There was no continuity in the resulting chips, the metal coming off in separate chips of the shape *M N O P*, see *A* Fig. 5. The metal *P R Q* shown shaded being compressed during the previous rotation of the bar and bulging out the chip as shown. At slow speeds Doctor Nicolson found the variation in the stress on the tool to be large.

The effect of bluntness of the tool edge at slow speeds may be seen by reference to sketch *A*, Fig. 5. When the edge becomes rounded as shown, the shearing action is supplemented by a bending action. This increases the forces necessary for the separation of the chip.

With an increase in the cutting speed the cutting becomes more continuous. The sketch *B* may be taken as indicating the cutting action at slow velocities. Here though the cutting be continuous it bears many characteristics of the previous case. There is a large variation in cutting stress and the bluntness effect is important. An examination of chip *A* Fig. 2 (cutting speed 7 feet per minute) shows the breaking up of the chip as shown in the sketch quite clearly. It is also exemplified to a lesser extent by chip *B*. It should be noted that these photographs were taken of the thick edges of the chips which show this characteristic most clearly. Where the chip is thinner it is less marked and the chip is considerably more continuous. This is probably partly due to the fact that the metal at the edge has more freedom of movement. The metal in the center of the chip has not the same opportunity to flow, being constrained by the metal in its immediate neighborhood. The effect of the bulging referred to in connection with the dead slow speed is particularly noticeable in these chips. The bulging it will have been noticed took place particularly at the lower part of the chip, that is, that against the tool face. This bulging results particularly in the base of the chip *S T*. This decreases the diameter of the helix of the chip. From consideration of all the chips it is seen that the diameter of the chip helix increases with increase of cutting speed. It may be stated, therefore, that other things constant the amount of work done on the chip to produce the bulging effect is inversely proportional in some degree to the cutting speed. It may be interesting here to refer to the diagram, Fig. 6, taken from Doctor Nicolson's paper

showing the variation in cutting stress with cutting speed.

Thickness of Chips

A noticeable effect of variation in cutting speed is the alteration in the thickness of the chip produced. This can be readily seen in the chips, Fig. 2. This, however, only shows the difference at the

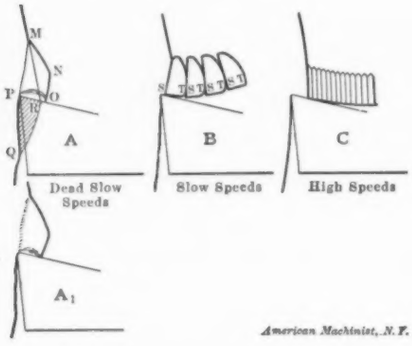


FIG. 5. CUTTING ACTION AT VARYING VELOCITIES

thick edge. To find the real difference the developed lengths of each were measured. They were then carefully weighed in a pair of accurate balances; *A* was found to be 35 per cent. heavier per unit length than *B*. For the reason of this increase in distorted area the compression or bulging effect cannot alone be due. The bulging takes place largely in the direction of the chip's length and only partially sideways—in a manner to increase the width of the chip. The reason lies chiefly in the different cutting action at the higher speeds. Here with the shorter period of passing over the tool the metal has not the same opportunity to flow. The shearing is not at all complete and takes place at shorter intervals as indicated by sketch *C*, Fig. 5. The separation of the chip from the bar here is due largely to a bending action. Due to this the edge of the tool does not enter into the separation of the chip to any large extent. A small pile of metal covers the edge. This metal is formed by scraping off the small irregularities left on the bar by the chip. A chip turned at moderately high speed often shows small patches of metal welded to the underside. They generally show a different color to the main body of the chip. These are portions of the pile torn away by the chip in passing over. An admirable illustration of the protection of the edge was given by a photograph of an O. K. tool on page 179. At higher speeds the chip also bears on the tool further from the edge. We proved this by covering two similar tools with a thin coating of copper and running one at a high and the other at a slow speed. The amount of copper rubbed away indicated the amount of contact between the tool and the chip.

Bluntness and Variation in Pressure

Of the factors which are affected by an alteration in cutting speed the bluntness effect and the variation in pressure on the tool are especially noteworthy. The bluntness effect is important at slow speeds and practically nonexistent at high speeds, and gives the reason for the fact mentioned at the beginning of the article: That tools too blunt to cut at slow speeds regain the ability to cut with an increase of cutting speed. This is particularly so in cases of cuts of slight depth where the rounding of the edge is large in relation to the depth sheared. With regard to the variations in cutting stress it may be generally stated that at high speeds the amplitude of the vibration is less but the frequency is greater. This is principally interesting with regard to chatter.

While on the subject of the effects in the variation in cutting speed it is perhaps pertinent to refer to the article by Mr. Herbert, on page 1063, Part 1, of the present volume. He there drew an an-

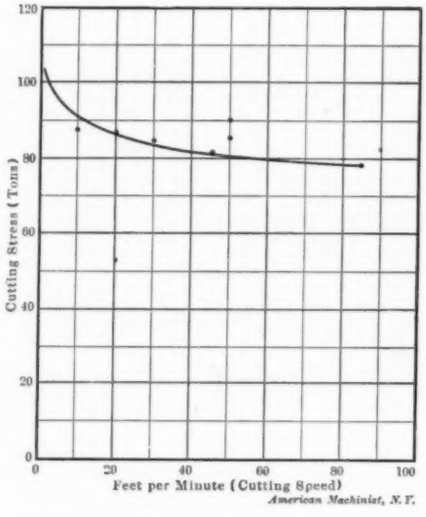


FIG. 6. CUTTING STRESS WITH SPEED-CUTTING ANGLE 55½ DEGREES, FROM DR. NICHOLSON'S EXPERIMENTS

alogy between the cutting action of a lathe tool and a jet of water playing on a wall. Since the heat generated in the latter case is proportional to the velocity of the water cubed, he drew the inference that this was the case as the former. A simple law was then formulated, i.e., that the cutting speed varied inversely as the cube root of the product of depth of cut by traverse squared (for equal durability) on the assumption that the durability of the tool was inversely proportional to the heat produced. An analogy between the action of a lathe tool and a jet of water cannot be drawn too closely. The pressure on the wall per unit area due to the water is proportional to the velocity squared. It has been found by Doctor Nicolson that with increase of cutting speed the pressure on the tool decreases (see Fig. 6). It may be fairly safely assumed, therefore, that the actions are not identical. Furthermore, is the durability of the tool simply inversely proportional to the heat produced whatever it may be?

The law deduced by Mr. Herbert,

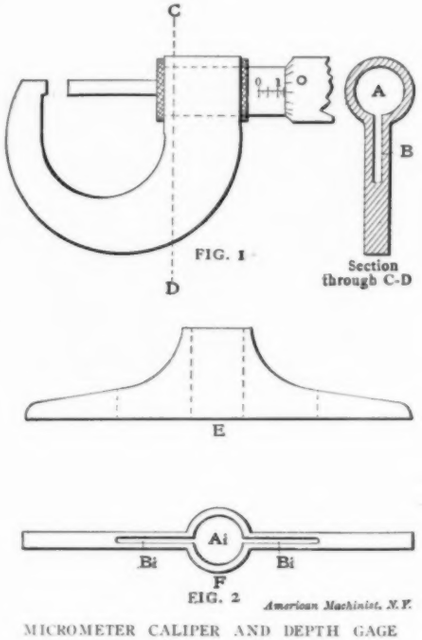
$$V = \frac{K}{\sqrt[3]{t^2 C}}$$

is of value. It raises again the question of the effect of increases of traverse, a point of difference between Doctor Nicolson and Mr. Taylor.

Micrometer Calipers and Depth Gage

By John Hubbard

Having a Starrett 1-inch micrometer head, and wishing to use it for measuring all diameters up to 6 or 7 inches without going to the expense of buying a full set; I forged a set of steel caliper frames, each 1 inch larger than the other, as shown in Fig. 1. The end *A* was drilled with a 31/64-inch drill and the slot *B* cut with a fine saw. A thin wedge was then inserted in the slot *B* springing it open slightly, and *A* then lapped or reamed until the body of the micrometer head would go in easily. On withdrawing the wedge from the slot *B* the head is held sufficiently tight for all practical purposes, especially if the head is fitted with a ratchet. This is better than having a screw to lock the head in the caliper frame as screws are apt to get lost or damaged and the thread stripped, whereas the calipers can be quickly changed by inserting the blade of a penknife in the slot. It is



MICROMETER CALIPER AND DEPTH GAGE

only necessary then to have a 2-, 4- and 6-inch standard end measure for setting the caliper. I also made a 1-inch depth gage on the same principle as illustrated in Fig. 2, which I find very handy.

Some Machine Tools Designed by Leonardo

Screw Cutting Lathes with Change Gears; Universal Chuck; Draw Bench with Self-closing Die; Drilling Jigs; Taps, Three in a Set, etc.

BY EDWARD P. BUFFET

The former article, which gave a general sketch of Leonardo da Vinci and his work, was admittedly sensational beyond the wildest audacity of yellow journalism. A task arising with the present paper is to substantiate some of the claims made. Present attention will, however, be confined to Leonardo's designs of machine tools, or, speaking rather more broadly, machinery and tools for working rigid materials, whether metal, wood, or stone.

First of all it is proper to state the indebtedness of this article to the pioneer investigations of Prof. Th. Beck, of Darmstadt, who has from time to time published in such German periodicals as the *Civilingenieur* and the *Zeitschrift des Vereines deutscher Ingenieure*, long monographs on Leonardo's machines, these papers comprising four series. The first was based upon Dr. Hermann Grothe's book, "Leonardo da Vinci als Ingenieur und Philosoph;" the second, upon the manuscripts in the Institute of France as published under editorship of M. Ravaisson-Molien; the third, upon the earlier sheets of the Codice Atlantico as they appeared in the great Italian *fac-simile* edition; and the fourth, upon subsequent sheets of the same. The first three series are collected in Professor Beck's book, "Beiträge zur Geschichte des Maschinenbaues," published under the auspices of the *Verein deutscher Ingenieure*. It is from the fourth, which has since appeared in the *Zeitschrift*, that by special permission granted the AMERICAN MACHINIST, I make most free to draw directly.

Professor Beck's reproductions of Leonardo's sketches are clarified and conventionalized line drawings. I have gone back to the original *fac-simile* editions of the manuscripts and copied the illustrations from them in many instances, either by photographing or tracing. The cuts printed herewith are, therefore, prepared by a variety of methods, according to casual expediency, and those which are photographic *fac-similes* will generally be apparent to the reader as such.

While it would not be worth while to encumber this paper with citations that are worthless to the casual reader, still it has been found possible to indicate concisely the places in Leonardo's manuscripts where the respective drawings may be found. This will prove invaluable for such as care to look up the sketches in the complete editions, which otherwise would be, like hunting for a needle in a haystack. The reference system employed is as follows: CA denotes the Codice Atlantico; thus CA359 means sheet 359 of the Codice Atlantico. I deem it unnecessary to specify the side or portion of the sheet from which the plate in question is made. Single letters, A, B, C, D, etc., denote the manuscripts of the Institute's collection; thus A24 would signify manuscript A, folio 24. These symbols are placed parenthetically in the text that describes the respective illustrations.

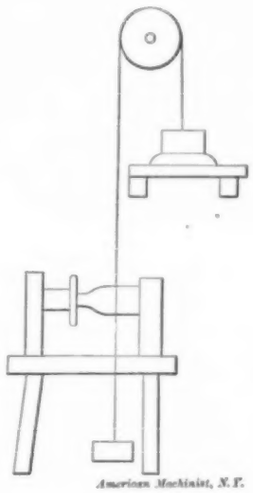
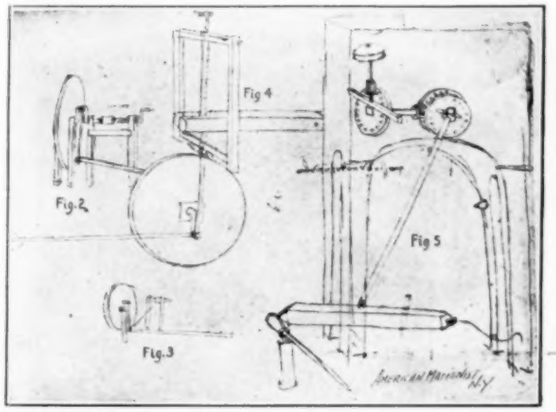


FIG. 1. CENTER LATHE WITH BALANCE WEIGHT



FIGS. 2-5. TWO LATHES, SAW AND DRILL PRESS (?)

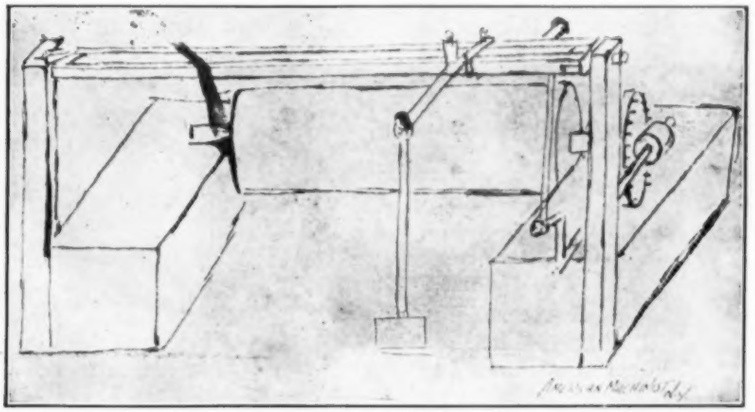


FIG. 6. LATHE FOR DRESSING COLUMNS (?) WITH GEARING

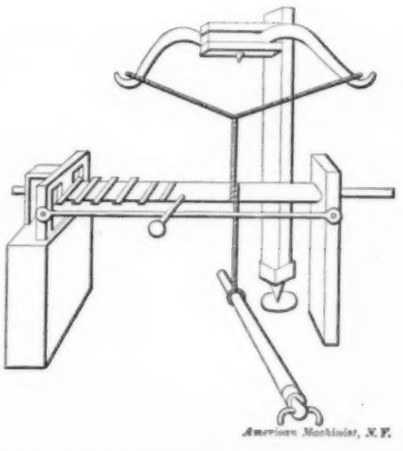


FIG. 7. SCREW-CUTTING LATHE WITH LEAD SCREW ON SPINDLE

LATHES

In early times, and in some that were not so very long ago, a common form of lathe was the pole or center lathe, in which a cord coiled around the spindle was alternately given a downward motion by depressing the treadle and brought back by a spring pole. Thus, the rotation was reversed after each cutting stroke of the treadle. A clumsy method it seems to us,

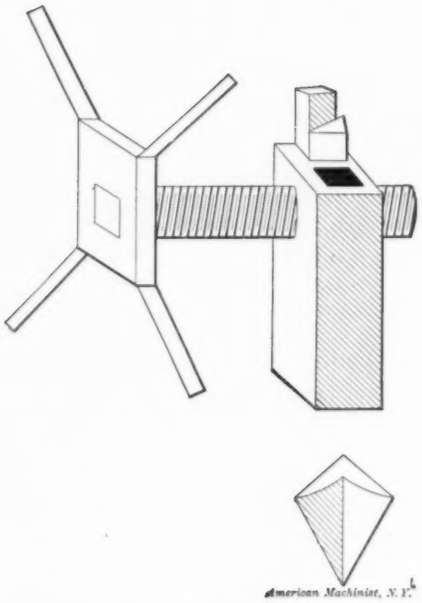


FIG. 15. SCREW-THREADING DEVICE WITH TOOL ANGLE

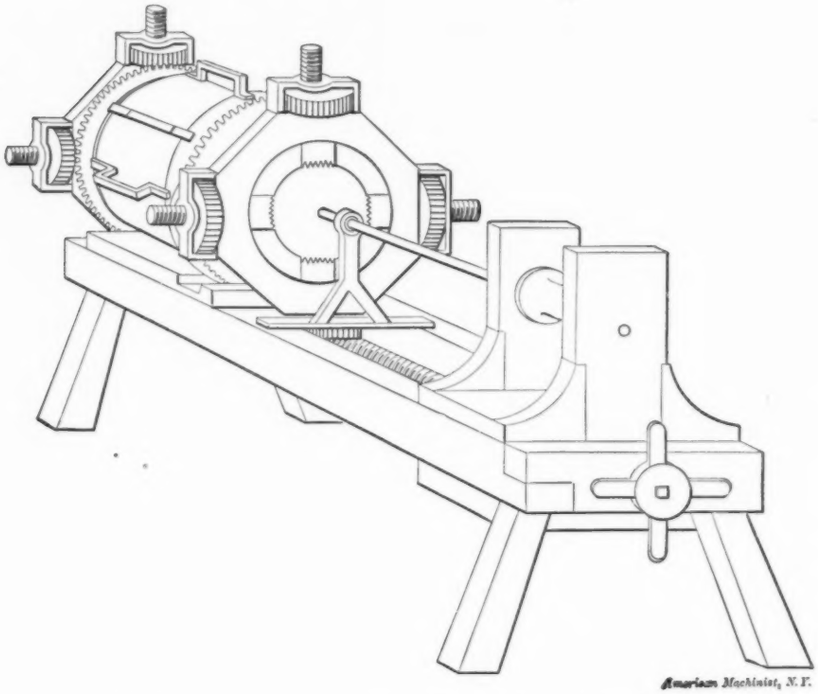


FIG. 21. HORIZONTAL BORING MACHINE WITH UNIVERSAL CHUCK

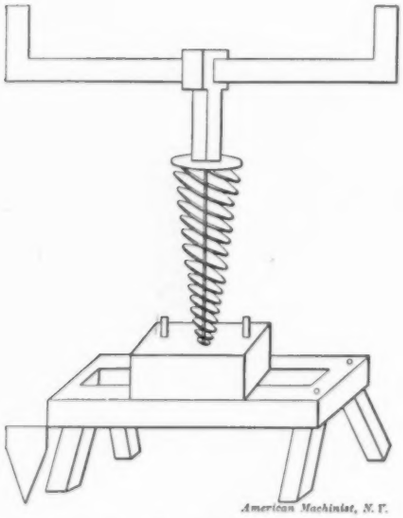


FIG. 16. FLUTED TAP

FIG. 18.

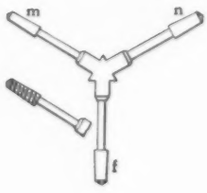


FIG. 19

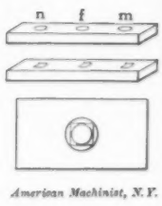


FIG. 20

FIGS. 18-20. TAPS IN SET OF THREE

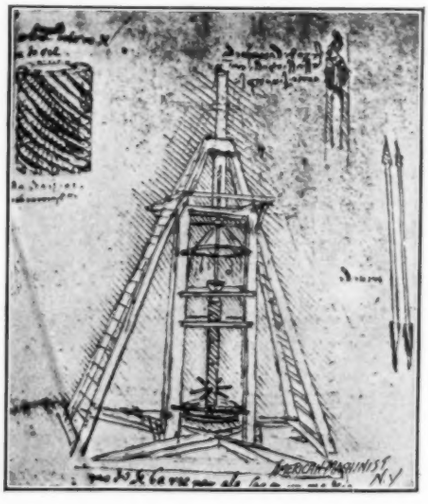


FIG. 23. VERTICAL BORING MACHINE

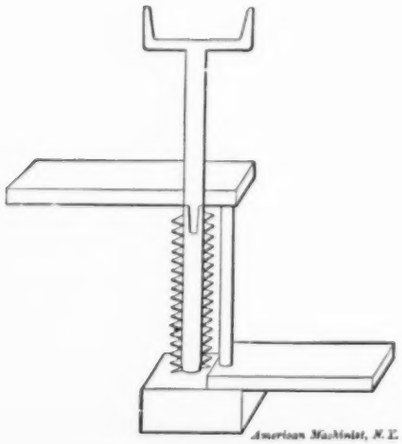


FIG. 17. TAP OR AUGER

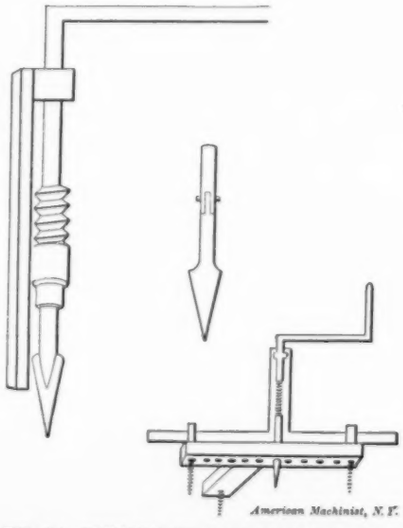


FIG. 24. DRILLING JIG WITH DETAILS OF DRILL

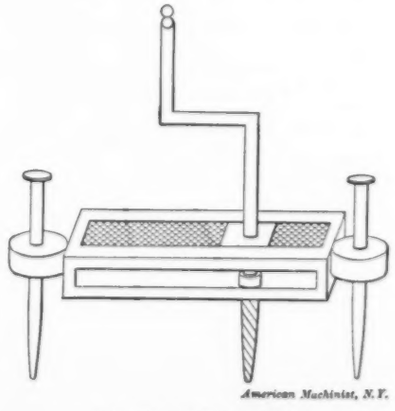


FIG. 25. DRILLING JIG

but its principle is very much like that followed in every reciprocating planer, where it appears to be unavoidable. Leonardo designed a reversing lathe, Fig. 1 (CA170) essentially like the pole lathe, but using a counterweight instead of a spring. He remarked that this is better because the force exerted throughout the stroke is constant. He makes this note also: "The cord roll has a steel axis, and the roll is of bronze."

But continuously revolving lathes were equally well known to Leonardo. Two such are shown in Figs. 2 and 3 (CA381).

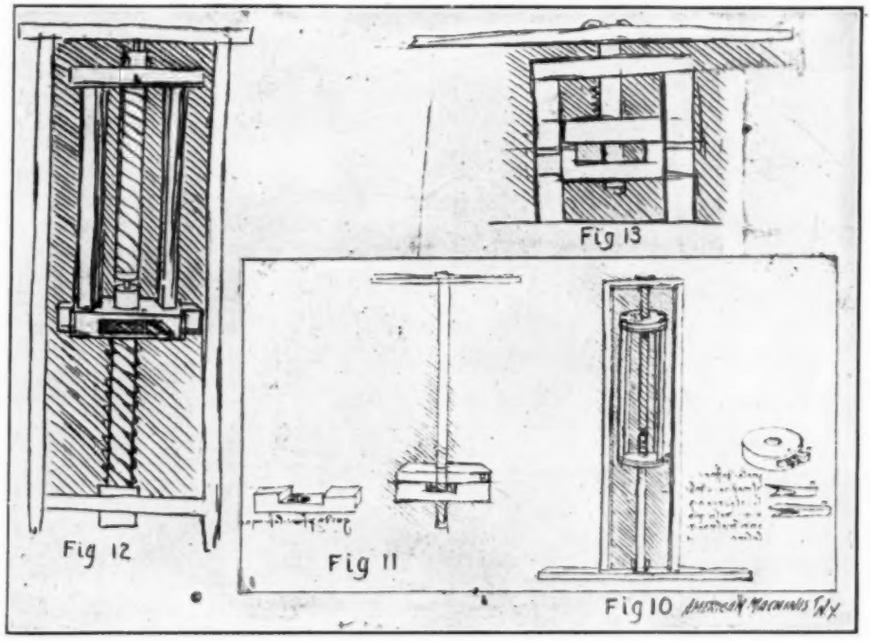
Fig. 6 (CA359) is an interesting machine without explanatory text, but evidently of lathe type. I pronounce it to be a machine for dressing wood or stone columns, driven by a geared crank connected with the treadle by a yoke above.

Thread Cutting

The subjects of turning and threading changeable sizes of which are shown under the table. The intermediate cross bar is the carriage, which contains the nuts through which the lead screws pass and which holds the cutting tool. The ends of the lead screws are held in boxes, adjustable in slots of the frame so as to accommodate the dimension of the gears in use.

A vertical type of this machine is indicated by the rough sketch, Fig. 9 (CA 365). An interesting feature here is the tool block with crank feed.

Threading tools which operate by means of master screws are presented in Figs. 10 (CA327) and 12 (CA355). In each, the upper screw is the lead, or master, which passes through a nut, or is engaged with a leader, in the top of the inside frame. It is obvious how the lower rod will be correspondingly threaded when the inner frame is twisted with respect to the outer one. An interesting



FIGS. 10-13. SCREW-CUTTING AND NUT-TAPPING CONTRIVANCES

overlap when they come to screw-cutting lathes. Such, in essence, is the machine shown in Fig. 7 (CA14). A master or lead screw and the blank to be threaded are coupled co-axially as a spindle. The part at the right hand serves as a drum for the cord which drives it on the pole-lathe principle; in the middle the screw is cut, and at the left or headstock end is the master screw, with a finger serving as part nut to give the travel. A slide rest is unnecessary, since the work moves longitudinally while the tool remains fixed.

A rapid and more complicated screw-cutting machine with change gears to provide different pitches is illustrated in Fig. 8 (B70). The screw to be cut is the middle one, and it is turned with a crank, which drives also the two lead screws on either side, by means of the gears, interdetail in Fig. 10 is the tool block with cutters. Fig. 13 is a nut tapper. The shank of the tap passing through the frame is assumed to be a screw. The cutting points, of increasing length, appear on one side only; during the operation the frame keeps the nut from turning. Fig. 11 may be taken for a tap of somewhat different pattern.

A simple nut-tapping method appears in Fig. 14 (B71) to which Leonardo appends some descriptive matter. The process is first to make a hole in the wooden block *m*, then to fasten on one side a strip of iron *a b*, crossing a small portion of the hole chordally. The tap *c d f r* is a wooden cylinder grooved like a screw, so that the bar *a b* may rest in the groove as a leader and cause it to advance through the hole when turned, while the cutter *d* which it carries taps the nut.

Another screw-cutting device is presented in Fig. 15 (CA56). The detail at the bottom represents the position of the cutter. A tap for the nut of this screw is illustrated in Fig. 16 (CA56). It is strikingly similar to modern taps in essentials of design, including the flutes. Fig. 17 (CA401) may be intended either for a tap or an auger.

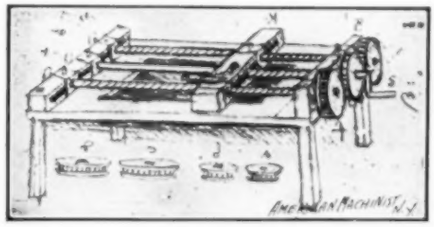


FIG. 8. SCREW-CUTTING LATHE WITH CHANGE GEARS

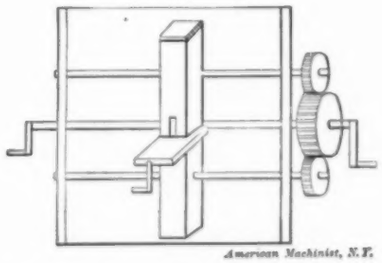


FIG. 9. SCREW-CUTTING LATHE SEEMINGLY INTENDED TO STAND UPRIGHT

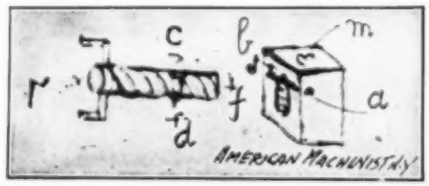


FIG. 14. TAP WITH ONE CUTTING POINT

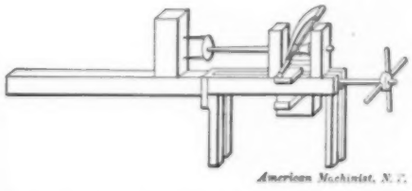


FIG. 22. BOW-STRING HORIZONTAL BORING MACHINE

The foregoing threading devices in general, the change-gear machine not excepted, were probably designed for cutting wooden screws and nuts. A triple tap for making metal nuts is shown in Fig. 18 to 20 (CA367). Its purpose is to do the work by three progressive stages. Fig. 18 shows how the sizes of the respective heads are proportioned, viz., as *m*, *f*, *n*, where *t g*, the small end of *m*, will just begin to enter the hole

bored in the nut *b l*, and *r o* is the diameter of the nut threads at the bottom. Leonardo tells us how a screw may be cast by means of the taps:

"If you will make the screw beautiful and smooth, make a nut in hard wood, with the thick end *n*, using first the thinner *f* and *m*, and then cast in this nut a screw of tin. Upon it make a form (mold) and cast in it a screw of brass or bronze. And when you have cast this, turn this screw in the holes *m*, *f*, *n*, (Fig. 20), to polish it; first in the larger and then in the second, and you will save the trouble of filing."

which meshed with crown-toothed rings, passing around the cylinder. As the rings were turned, the jaws moved toward the center symmetrically. It appears that the rings at either end of the cylinder were connected by several handles so as to be turned together, thus producing a symmetrical advance of the jaws at the two ends. If this was the case, the log must first have been turned to a uniform diameter throughout its length, for if tapered, it would be necessary to move the jaws nearer the center at one end than at the other. The application of power to the spindle in the headstock at

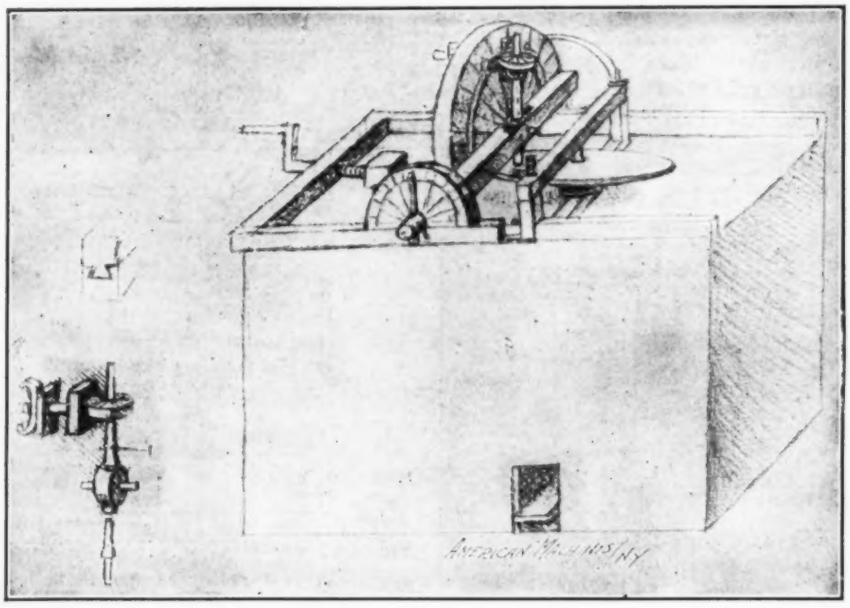


FIG. 26. UNIVERSAL VARIABLE-SPEED FRICTION DRILL WITH INDEX DIAL AND FOOT-POWER FEED (?)

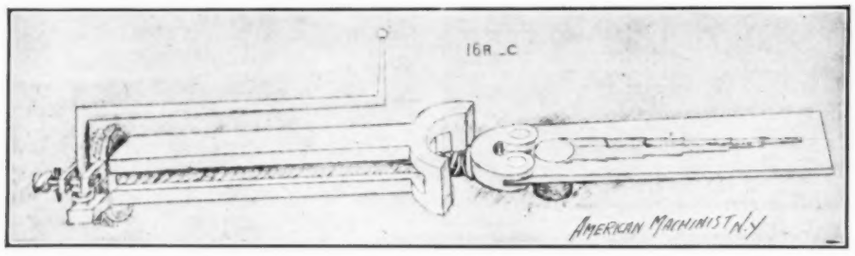


FIG. 27. EXTERNAL BROACH OR SAW FOR CUTTING OFF IRON BARS

Boring and Drilling

A precocious device is the horizontal boring machine, shown in Fig. 21 (CA393). It was one of those selected by Herr Grothe from the Codice Atlantico before publication of that manuscript in *facsimile*, and we now show it in revised reproduction. The machine was intended for boring wooden water pipes. The log to be pierced was held in a fixture consisting of a hollow wooden cylinder, with octagonal flange ends. Through each of these annular ends passed four centrally directed screws, ending in toothed jaws for clamping the logs. These screws were advanced by gear wheels which formed their nuts and the right-hand end for driving the drill is not shown, but the shape of the pulley, so far as visible seems adapted to a bow-string drive, as in Fig. 22, following. The feed of the logs against the drill, or *vice versa*, by means of a lead screw in the bed and turned by a hand star wheel at the front, is obvious enough. The most remarkable feature of this surprising machine is the self-centering chucking device, which, had it been adduced in evidence at the right time, would probably have made mince-meat of some of the basic patents on modern chucks. Centering devices were a favorite subject of Leonardo's ingenuity. One of them, which is not shown here, is suggestive of

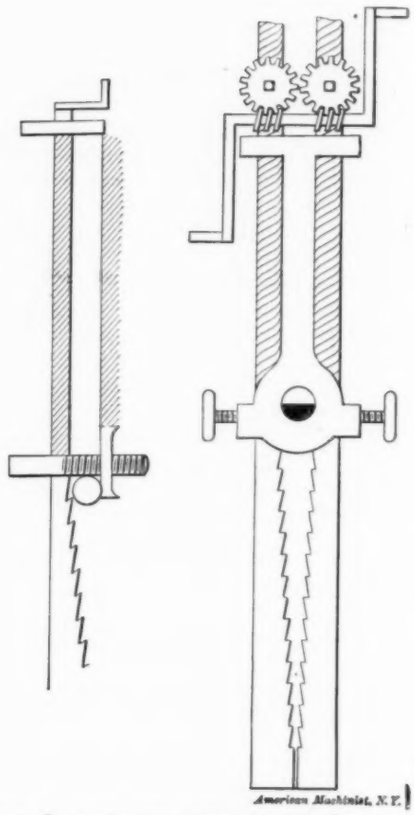


FIG. 28. VARIETIES OF THE BROACH (ASSUME THAT THE GEARS ENCIRCLE THE SCREWS)

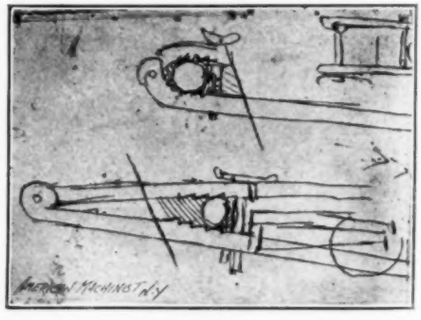


FIG. 29. BAR CUTTERS OR WRENCHES

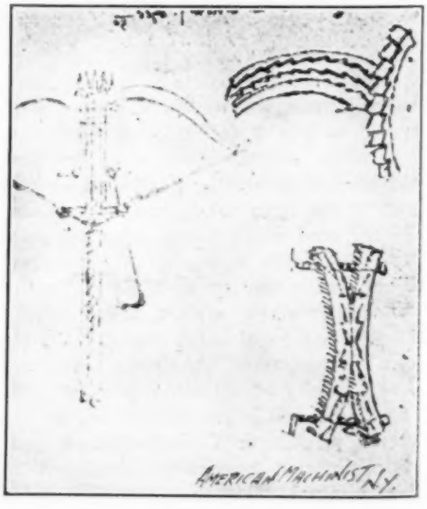


FIG. 30. BROACH TEETH AND A CROSS BOW WHICH IS A TRESPASSER

the iris diaphragm common on camera shutters.

In Fig. 22 (CA38) is a horizontal drill, which is given an alternating motion by hand, with a bow whose cord passes around the spindle between the uprights of the headstock. This headstock is fed toward the fixed work by a lead screw turned by the star wheel at the right hand. The drilling tool depicted is adapted to cutting out a core.

A vertical machine for endwise boring of a beam or leg of wood is seen in Fig. 23 (B47). The beam was placed at the top of the frame, head downward toward the drill, and the boring tool was set in a screw which rose as it was turned by the workmen. A funnel-shaped canopy was placed to keep the chips from falling on their heads, and to allow free egress for the chips the bits were fluted, as shown in the detailed view. It is evident that the beam was fixed, since for the feed dependence was not placed upon its weight, but upon the upward advance of the screw. Leonardo directs that the hole be made first with a fine bit and afterward with a coarser one. The object at the upper left-hand corner of the plate, which looks like a milling cutter or hob is evidenced by an accompanying note to be intended for a staircase, which exemplifies the promiscuity of Leonardo's sketches.

To think of Leonardo da Vinci as a designer of drill jigs is enough to take away one's breath, but to no other purpose can I ascribe the devices shown in Figs. 24 (CA401) and 25 (CA353). Neither has been reproduced by Professor Beck. The jig in Fig. 24 consists of a T-shaped frame, screwed down at three points, the cross piece of the T containing a row of holes through which the bit passes. The shank of the spindle is threaded through a nut on the upright, so that it feeds as it is turned. The detail views show the construction of this feed screw and the attachment of the bit to its spindle. The jig in Fig. 25 is formed by a straight horizontal guide, spiked or screwed down at the ends, and along which can be moved at pleasure a block through which passes the shank of the bit. Quite likely this block is threaded to feed the bit automatically, as in the other jig.

Returning to Fig. 5 on an earlier plate we find a machine which strongly suggests a foot-power drill press. We notice two crown gears with teeth directed toward a pinion between them, like a differential motion, or a speed-reversing device. A crank operated by the connecting rod is not evident from the sketch, if it exists at all. The feed seems to be produced by a simple pressure downward upon the hand wheel. The table and its support is omitted, and what there may be to block up the work is confused with the end of one of the spindles. Whoever can more plausibly indicate the purpose of this machine, however, is welcome to do so.

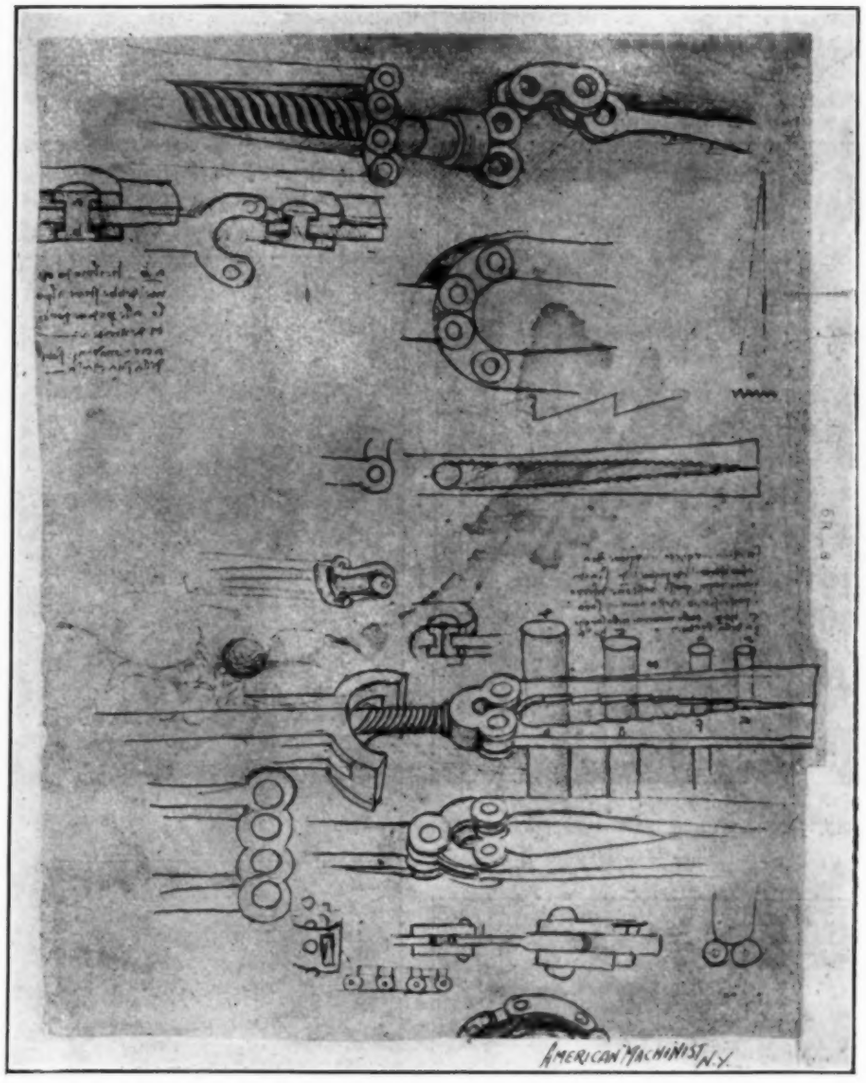


FIG. 32. BROACHES AND BROACHING—DESIGN OF DETAILS

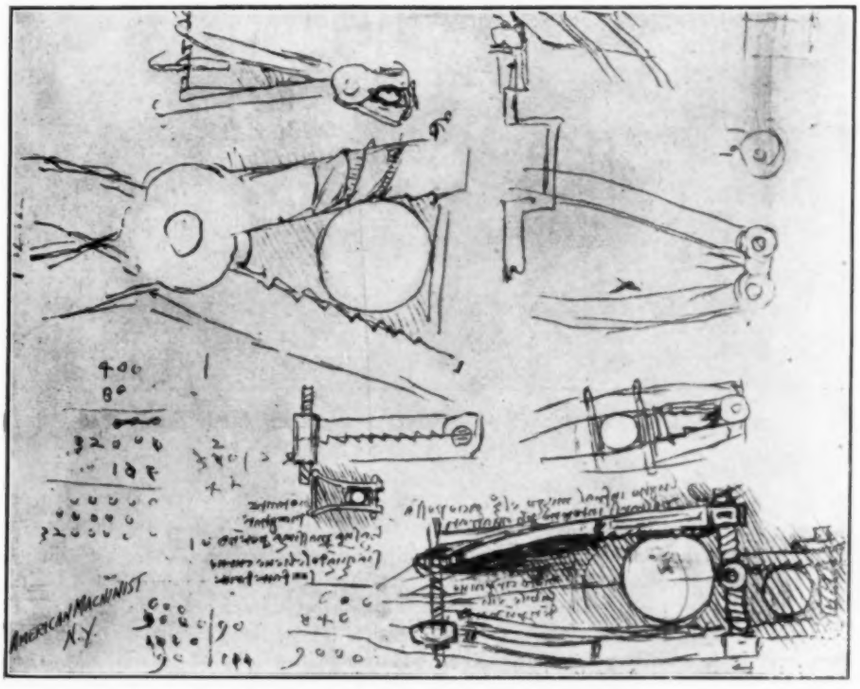


FIG. 31. STUDIES IN BAR CUTTERS AND THEIR TEETH

While it is not desirable to encumber this article with illustrations of machines whose use is unknown, the crayon drawing reproduced in Fig. 26 (CA294) is

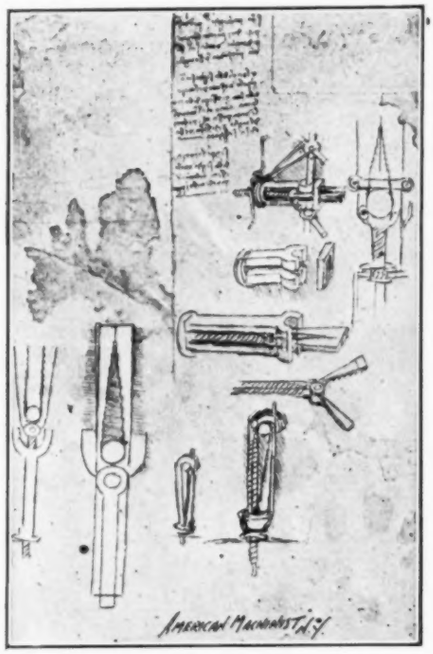


FIG. 33. BROACHES OR CUTTERS WITH SPECIAL FEATURES

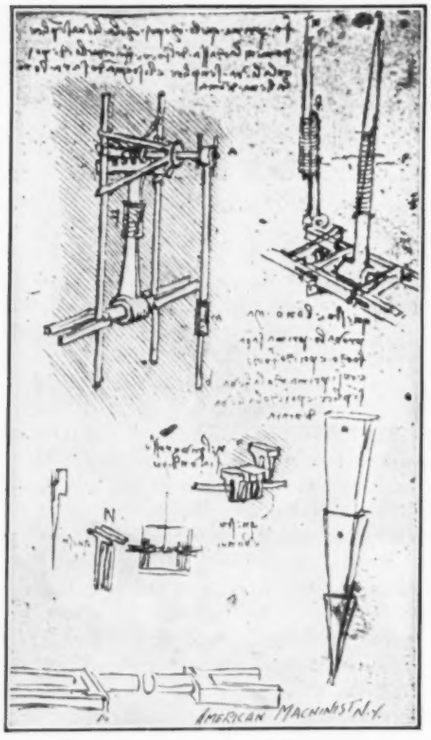


FIG. 34. MACHINE FOR WRENCHING BARS OF GRATINGS

far too good to leave out. The details of its mechanism are startling in their suggestiveness of most modern devices. Assuming that the small disk on the spindle has a vertical motion across the face of the large disk, their combination is identical with well known speed-changing devices in use today. Why may it not be called a universal friction drill? Observe the seeming index dial at the front, and the round table at the right. The treadle may be intended for driving the machine or for pressing the table up against the work. The application of the crank at the left of the machine is not obvious. A detailed view of the spindle is given in the lower left-hand corner, and this shows what looks like the detached bit, thus strongly favoring the assumption that we have before us a drilling machine. Otherwise, its most likely purpose is that of a grinder, for Leonardo was bold and prolific in his design of machines for grinding curved surfaces.

Broaching

A favorite exercise of Leonardo's inventive genius was the design of external broaches for cutting off iron bars. There

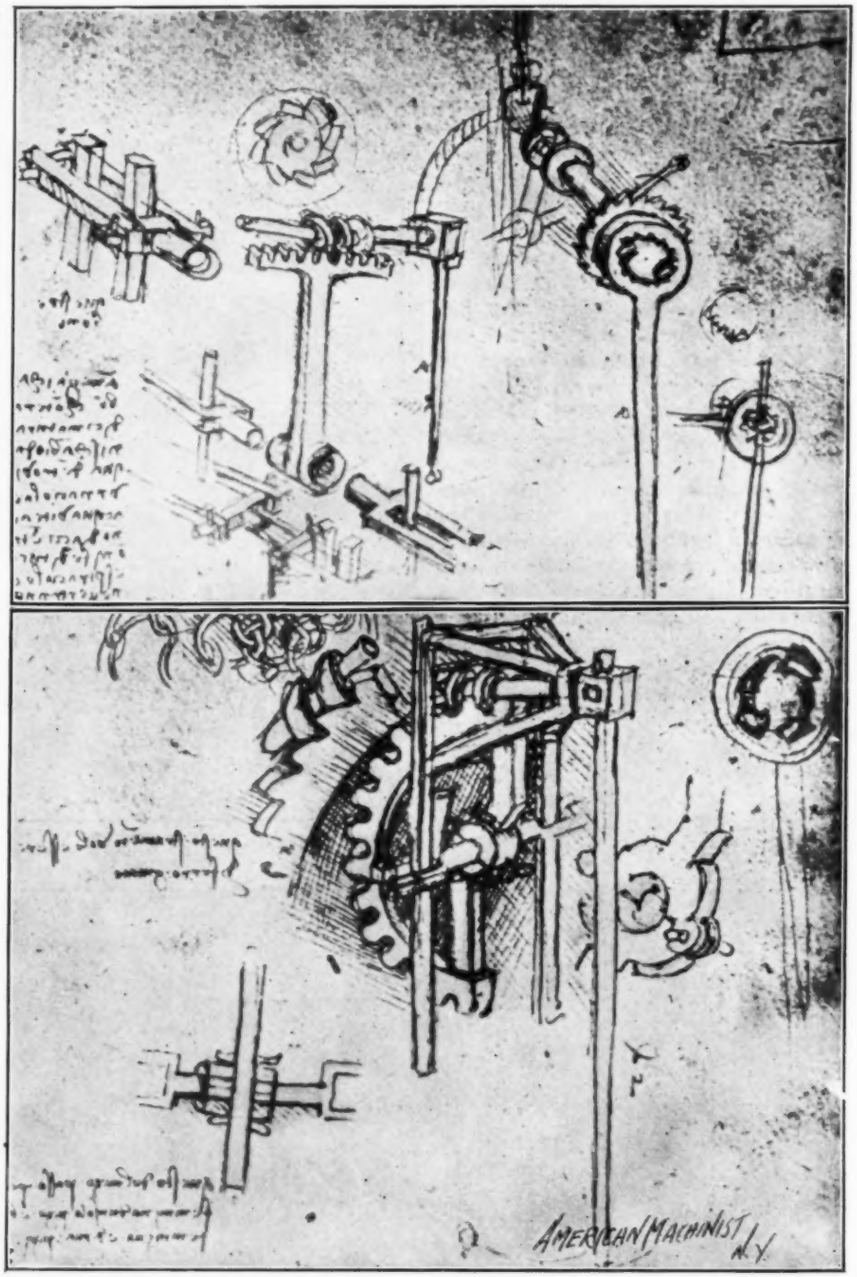
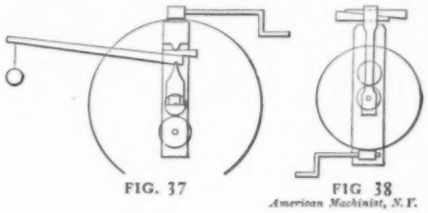


FIG. 35. DETAILS OF WRENCHING MACHINE—RATCHET LEVER; WORM GEAR SEGMENTS WITH PECULIAR TEETH

is reason to believe that these tools, or some of them at least, were intended for the military purpose of breaking through gratings of fortresses and walled cities. This inference may be drawn from the fact that a device for that object is shown in the book of Ramelli, who lived about a century later than Leonardo, and also from the circumstance that one

of da Vinci's own broaches is shown applied to a grating bar.

One of the finest examples of these broaches is depicted in Fig. 27 (CA16). The jaws of the broach are hinged and open to admit the bar. They are drawn into a housing by a screw whose nut is a gear meshing with a worm turned by a crank. As they enter the housing the socket on the end of the latter is brought to rest against the bar, and at the same time the strap formed by the closed sides of the broad slot prevents the jaws of the broach from opening. As the successive teeth in the two jaws are drawn over the bar, the space between them grows narrower and narrower, until finally the rod is severed.



FIGS. 37 AND 38. ROLLING MILLS FOR SMALL WORK

Fig. 28 (CA375) shows a variety of this broach, in which the two jaws are drawn by independent screws, and the pressure on their back to hold them against the bar is produced by adjusting screws. The broach at the left seems to require but a single cutting edge.

Fig. 29 (CA27) contains some very crude but equally interesting sketches of other varieties of the external broach or bar cutter, noteworthy among which is the one which closely encircles the bar. This wonderfully suggests a modern form of pipe wrench and quite as likely was made for gripping and wrenching the bars as for cutting them.

FIG. 36. ROLLING MILLS FOR TIN FOIL

The device shown in Fig. 30 (B27) is evidently a symmetrical pair of broaches taken up by screws at both ends and having teeth which run toward the center. The same plate contains studies of toothing for similar broaches.

To show the infinite variety of Leonardo's mind when it was working upon any subject, may profitably be reproduced three more plates filled with odds and ends of sketches of broaches and their details, Figs. 31 (CA315), 32 (CA6) and 33 (CA6). Note in Fig. 31 the broach with a suggestion of teeth cut helically around one of the jaws; also its pincer-like form. Observe in the upper right-hand corner of Fig. 33 the broach whose jaws are held together by a strap around them, provided with anti-friction rollers. Immediately to the left of it is the broach already referred to applied upon a grating bar. It is braced by cords to the cross bar next above it in order to maintain its horizontal position while cutting. At the bottom of the plate, nearest the right hand, is a broach with a single jaw, the other jaw being replaced by a stout hook formed by the end of the screw which pulls the rod against the teeth.

A Bending Machine

The tool of Ramelli, already referred to, was an instrument for wrenching, rather than cutting the bars of the fortress grating.

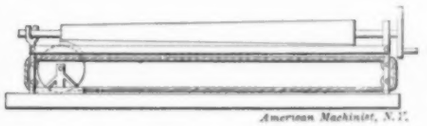


FIG. 41. GRINDER FOR SPIRAL DISK ROLL

For a similar purpose was intended the rod-bending and breaking machine of Leonardo, next to be described. It is illustrated in several assembled and detailed sketches, of which we select for reproduction three, Figs. 34 and 35 (B71-73). Two forks are passed over a pair of grating bars, their openings directed apart and their threaded shanks screwed into a common hub carrying a lever at right angles to its axis. Turning the lever unscrews the shanks and thrusts the forks apart, thus bending the grate bars somewhat. Then the lever is reversed sufficiently to allow the insertion of T-shaped wedges between the bottoms of the forks and the bars on which they rest, and thus the grating opened by suc-

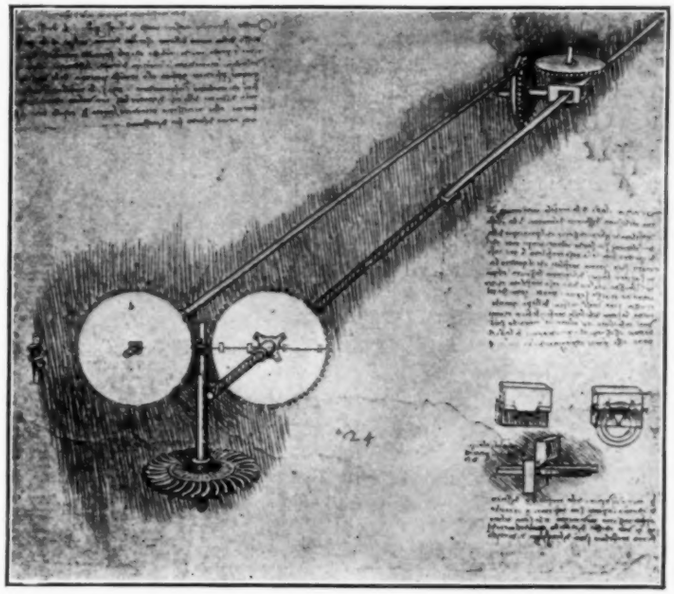


FIG. 39. DRAW BENCH FOR BARS OF PECULIAR SECTION WITH AUTOMATICALLY CLOSING DIE TO PRODUCE TAPER

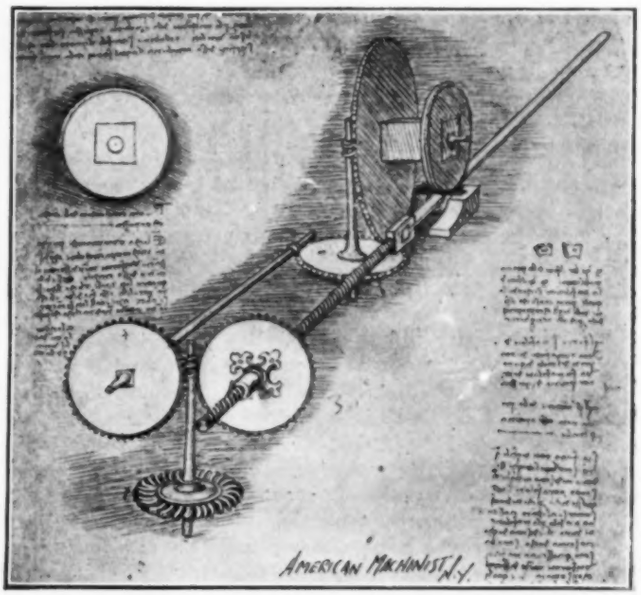


FIG. 40. ROLLING MILL FOR SAME WORK—TAPER OF BAR FORMED BY SPIRAL PERIPHERY OF ROLL

cessive stages. If the simple lever does not give power enough, there may be coupled to it a gear segment turned by a worm in a frame which rests against the bars higher up. The lever for screwing this worm is provided with a ratchet.

Rolling and Drawing

Two forms of rolling mill, or two partial views of the same rolling mill, for tin foil or plate, are illustrated in Fig. 36 (148).

Figs. 37 and 38 (CA370) illustrate rolling mills, which, as Leonardo's text indicates, were intended for making gold plates or window leads. They are worm driven. A feature of note in Fig. 37 is the maintenance of constant pressure by a weighted lever.

In the time of Leonardo Da Vinci there were used for the manufacture of cannon

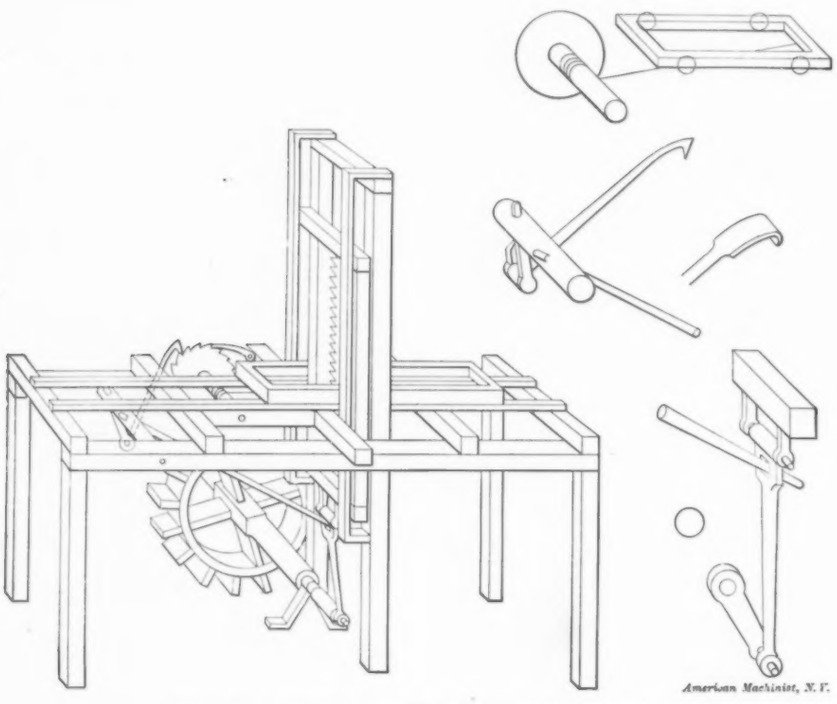


FIG. 42. SAWING MACHINE WITH AUTOMATIC FEED

linings bars of wrought iron, shaped and put together essentially after the manner of pipe staves. Obviously this required a very special section, the inside of the bar being hollowed, outside rounded and the edges beveled, while, to add to the difficulty, the strips were tapered in thickness at right angles to the axis toward one end. For the manufacture of these bars, Leonardo invented two forms of machines, one a draw bench, and the other a rolling mill.

The drawing machine is shown in Fig. 39 (CA2). It was driven by water power, for though, as Leonardo remarked, the operation was possible by hand power, this would be too slow. Notice in passing may be taken of the curved buckets on the water wheel. A worm on the shaft of the wheel meshes with two gears, and through a nut in the center of one of them passes a long screw that pulls the bar through the die as this wheel turns. The other gear is mounted on a rod with a worm at the opposite end. This second worm engages with a gear train which closes one side of the die like a valve gate, so as automatically to taper the bar while being drawn through. It will be noted that there are two gears at the die end, each apparently meshing with the worm, as if two sides of the die were simultaneously being closed, and thus a double taper produced. The original sketch (which is torn at that point but restored by the artist who retouched the photograph for engraving) does not render certain whether this is so or not, and the conventionalized drawing in Professor Beck's book indicates that the worm is in mesh with both of those gears. The descriptive matter and detailed drawings of the die, however, support a contrary opinion. If there are two closing movements they probably are not in service at the same time. More than one operation is required to form the different sides of the bar. Leonardo mentions that a little bur will be formed which may be beaten down after assembling of the staves. A new die is recommended for each bar, because of the wear.

The rolling mill, Fig. 40 (CA2), designed as a substitute for the draw bench is identical so far as the water wheel and mechanism at the driving end are concerned. According to Leonardo's description, the bar, after having been forged to an approximate shape with a hammer, is rolled by three or four operations. First, the inner, channeled, side is formed; then the edges, and lastly, the outside, for which last purpose is employed a roll with spiral periphery in order to produce the taper.

On the same plate as the foregoing is Fig. 41, in which a disk similar in appearance to the spiral roll is set in a machine of different character. By means of a rope belt it may be pulled back and forth along the guide in a plane at right angles to its axis, and if, meanwhile, turned, its edge will remain in contact with the conical roll above. If the conical roll be revolved simultaneously, a helical path will be traced upon it by the spiral

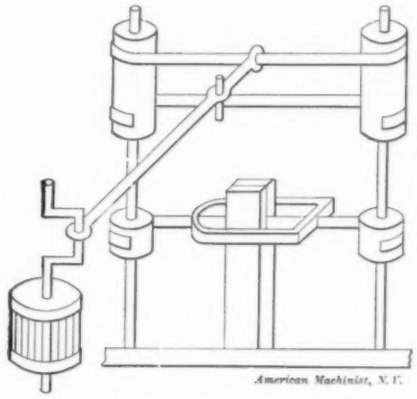


FIG. 43. SAW DRIVEN BY RECIPROCATING BELTS

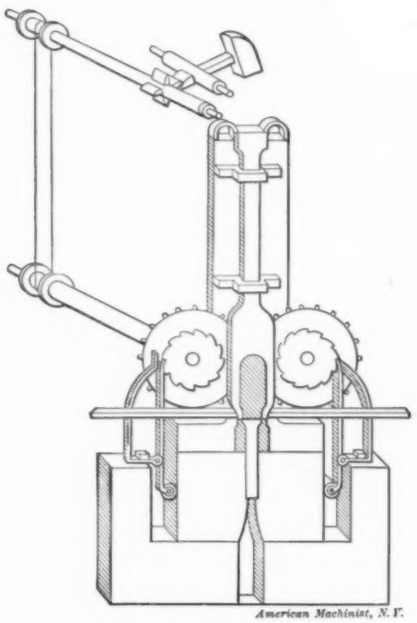


FIG. 44. PUNCH PRESS WITH AUTOMATIC ROLLER FEED

disk. On the conical roll is a legend "copper with emery." This machine is evidently intended for grinding the spiral disk with the proper curvature, both in outline and in concavity of the edge.

Saws

Sawing of marble into slices is an art which dates long before the Christian era. A type of saw invented by Leonardo is

said to be still used in the Carrara quarries. A number of sawing machines for marble or wood, as the case may be, appear both in the "Codice Atlantico" and his other manuscripts. A very simple saw is shown in Fig. 4 on a previous plate.

Fig. 42 (CA) illustrates a sawing machine with automatic feed. The bladed wheel is apparently a water wheel. Its shaft drives the saw by crank and con-

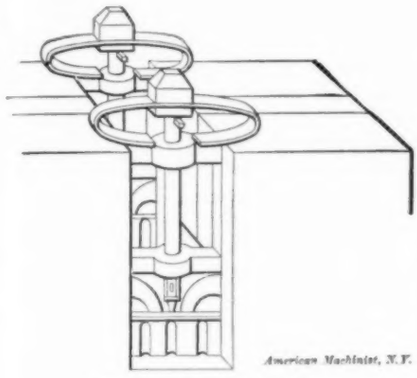


FIG. 45. DUPLEX PUNCH

necting rod, while a hook operated from the rod acts on a ratchet wheel to advance the carriage.

Fig. 43 (CA389) illustrates a movement for a stone saw. The reciprocation is produced by the alternate rolling and unrolling of belts, one of which is attached to a lever oscillated by a crank. To interpret the sketch, note the indicated pivot of the lever.

Single and duplex horizontal saws ap-

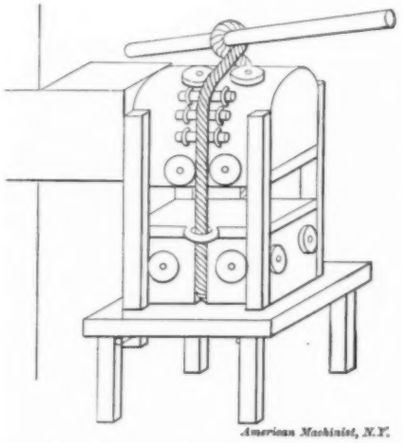


FIG. 50. PRESS ACTUATED BY TWISTING A ROPE

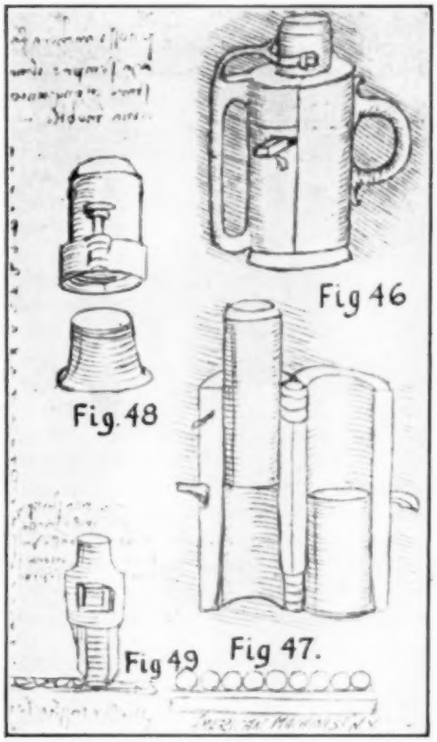
pear in sketches which are not here reproduced. He designed one blade with double-acting teeth, that is to say, intended for cutting in either direction.

Stamp and Press Work

In Fig. 44 (CA393) is a machine apparently intended for stamping out small rings and disks from a metal band moved by an automatic feed. The blow on the punch is administered by a small trip hammer and the feed is connected to it with a belt which is noteworthy because the use of belts is regarded as quite modern. While Leonardo made less use of belts than of other methods for power transmission, he employed them in a number of cases, showing that they were not unfamiliar to him. He even in one instance employed crossed flat belts and studied their properties.

Fig. 45 (CA3) is a simpler duplex punch probably driven home by a hand hammer. The punches are raised by springs.

Several forms of coining dies and punches for minting Roman money appear in Figs. 46-49 (G43). The die holders were made in segments, with hinges and latch, to insert the blank and remove the coin. The die in Fig. 47 is open, while



FIGS. 46-49. STAMPING AND TRIMMING DIES AND PUNCHES FOR ROMAN MONEY

Fig. 46 shows the upper punch held by a spring. In Fig. 48 the holder seems to fit over the lower punch. Fig. 49 is a trimming die for the coins. Leonardo's remarks on the same page relate largely to making the coins round and uniform in thickness and weight. The Italian minting practice must therefore have been ahead of that in some other countries where coins were very irregular in shape, and hence could be clipped without compunction as they passed from hand to hand. These dies represent the period of Leonardo's brief residence in Rome a few years before his death.

A press empowered by twisting a rope, somewhat on the Spanish windlass plan, is shown in Fig. 50 (CA315). The provision with anti-friction rollers is more elaborate than so simple a device would seem to call for.

In the next article will be shown more of Leonardo's machine tools, no less remarkable than those already described, among them some which are highly automatic.

Automobile Horsepower

By F. W. Brady

The sales representatives of several firms building automobiles have recently stated to the author that the term "horse-

Bore.	Stroke.	Number Cylinders.	Rated Horsepower.	Calculated Horsepower.	Revolutions for Calculated Horsepower.
3½	3½	4	24	17.00	1410
3⅜	3⅜	4	16.9	14.21	1190
3½	4	4	22	22.04	1000
3½	4½	6	35–40	36.50	960
3½	4½	4	20	25.20	800
3½	5½	4	20	28.60	700
3.94	5.12	4	30	31.30	960
4	4	4	25–28	25.40	....
4	4	4	30–35	25.40	1180
4	4½	4	30	28.60	1050
4	4½	4	35	28.60	1225
4	4½	4	25–30	28.60	....
4	4½	4	25.6	28.60	900
4	4½	1	7.0	7.15	980
4	4½	6	36.0	45.20	800
4	5½	4	30.0	33.40	900
4	5½	4	18.0	33.60	590
4¼	4¼	4	30.0	31.20	965
4¼	4	2	16.0	14.30	1120
4¼	4½	4	30–35	32.20	....
4¼	5	4	30	35.70	850
4¼	5	4	40	35.70	1120
4¼	5½	6	40	59.00	680
4¼	5½	4	40	38.10	1050
4½	4½	4	30	35.00	860
4½	4½	4	30	36.20	830
4½	4½	4	15–30	37.10	....
4½	4½	6	48	55.00	875
4½	5	6	60	60.10	....
4½	5	6	48	60.10	800
4½	5	4	32	40.30	792
4½	5	6	50	60.10	832
4½	5½	4	35	42.20	830
4½	5½	6	60	63.20	950
4½	5	6	48	63.50	760
4½	5	4	45	44.70	....
4½	5	4	40	44.70	900
4½	4½	6	40	60.50	660
4½	5½	4	40	46.00	870
4½	5½	4	40–45	49.30	....
4½	5½	4	30	52.00	580
4½	5½	6	50	78.00	640
5	4½	4	40	45.20	885
*5	5(2cycle)	4	50	49.50	....
5	5½	4	30	54.40	550
5	5½	4	50	57.20	875
5½	5	2	30	27.30	1100
5½	5½	4	45	60.20	750
5½	5½	6	70	98.70	710
5½	6	4	48.4	72.00	672
5¼	5¼	4	60	76.50	780

*Not reliable from data at hand. Calculations based upon 100 pounds means effective pressure and 1000 revolutions per minute.

A COMPARISON OF MOTOR-CAR ENGINES OF 1910 CARS.

power" as applied to gasolene-driven vehicles, "means nothing." Thus, this industry is being deprived of about the only means of comparison and classification which will allow the purchaser to gain a logical idea of the capabilities of the motor in a car of his selection. It has been apparent for some time that, in some instances, power ratings have been going up

with a simultaneous decrease in cylinder dimensions, or with then existent sizes.

The engineer's old reliable formula for horsepower, providing a number of foot-pounds per minute, divided by 33,000, embodies variable factors, which in a gasolene motor at its fullest power usually remain practically constant with the exception of the number of revolutions. That is to say, that with the current practice in cylinder proportions, valve dimensions and timing, form and position of intake and exhaust ports, location and timing of means for ignition and adjustment of the proportions of air and gas, two well designed and carefully constructed motors of the same cylinder dimensions, should generate about the same horsepower at like speeds, provided, of course, they are functioning on the same stroke cycle.

With large valves and an early spark the automobile motor may be speeded to extreme limits, dependent somewhat upon the efficiency of the carbureter, so that with proper lubrication the most amazing powers may be developed for short periods. Rating a motor according to the power at such extremes is hardly consistent with the power available at speeds which will not rack the motor.

After an endeavor to ascertain the bases on which horsepowers are reckoned, it was found that hardly two motors are rated with the same factors in a formula. It is true, however, that two-cylinder dimensions have been generally accepted for a four-cylinder, four-stroke cycle motor—as a "30," as an instance—on the basis of crowding the motor to its limit. According to selling price the amount of "reserve" power, or that obtained by forcing, is determined.

The power of a motor should be that developed at a number of revolutions possible of maintenance for long stretches on the road with the direct drive in use. It cannot well be determined in actual road service, but could be closely approximated on the test block. With similar test conditions there would be no necessity, in powering the cars, to give any more or any less than that specified, and the purchaser could gain an idea of what he was receiving for the purposes of comparison. It would not enlighten him in regard to possible speed at the full power, as cars vary much in weight and friction also enters as a factor. For instance, if a car is guaranteed to speed 60 miles an hour, who is going to demonstrate this qualification? Under what conditions of road, wind, temperature and time is this speed to be maintained?

Motors of 1910

The specifications of many 1910 motors have been examined and for the possible power outputs, in the table appended, they have all been placed on the same basis as to mean effective pressure and speed. The powers calculated are those which would be derived from the indicated work in the cylinders without regard to the counter-effort of overlapping compressions. It was intended to draw a line through the middle and compare on both sides.

Assuming that every advantage is to be given to the motor and not the formula, the effective pressure is taken at 100 pounds per square inch; the number of revolutions per minute, 1000; no allowances have been made for friction, inertia of moving parts, ratio of bore to stroke, or of connecting rod to stroke. Then the formula for indicated horsepower has been employed, by using the number of explosion impulses per minute instead of revolutions. This would determine the mechanical efficiency of the motor as 100 per cent., not possible, but suitable for comparison.

Without stating the builders' names the figures given illustrate the vagaries of power rating, a few examples being cited not particularly as a criticism, but to give prominence to the fact that readjustment of the values might be advantageous by the universal selection of a service condition intelligible to the buyer, and founded by the builders upon either of two theories: one considering the developed power with a fixed percentage of reserve, the other based on the utmost the motor can develop with forcing.

Beginning with the cylinders of 4-inch bore, or less, we find one 3¾x4 inches, 22 horsepower; another, 3¾x5⅛ inches, 20 horsepower; still another, 3¾x4½ inches, 20 horsepower. On the 100 per cent. basis the calculated indicated powers of these motors determine the first to just equal its rating; the second figures 30 per cent. higher, and the last 20 per cent. higher than its rating. Something must happen with the motor under its rating; the mean effective pressure can hardly be raised above 100 pounds, so we must increase the speed to obtain the stated power, not materially in this case, but sufficient to provide for the difference between indicated and brake horsepower. It seems to be demonstrated that this is a 22 motor; that no more can be secured without pressing, and its rating is a logical basis for a sale unless a sort of "overload" clause is included in the guarantee. No other industry will give 2 pounds when but 1 is paid for, and why should the automobile builders countenance this fallacy?

The cylinder with a bore of 4 inches and 4½-inch stroke is quite popular, the motors ranging with four cylinders from 25 to 35 horsepower. At the assumed logical speed adopted herein, several of those in the table might be considered as overrated; the calculations giving but 28.6 at 100 per cent. efficiency. Without some startling features in the motor the one rated at 35 horsepower must be driven over 1300 revolutions to reach its maximum, which may or may not be desirable.

Selecting the 4x4-inch motor as another example, the power in one instance is rated 30-35. This is quite different from the same motor power obtained with ½ inch more stroke and means still higher speed or great skill in design.

Going to the extreme in reserve provided, one motor listed as 4 1/16x5⅛ inches, 18 horsepower, seems to determine that the builders are too conservative in the rating, even when considering a low speed of the motor, and while the cost of the car may include the reserve power, and such a motor might be serviceable for a much greater period than one rated to its limit, it proves the necessity for uniform ratings with certain fixed and agreed factors.

It is notable also that motors 4¼x5, 4¼x4¼, 4¼x4½ inches are also classed as 30's, each builder putting his own classification into effect.

A diameter of 4½ inches is adopted by numerous builders with a great variety of strokes but with consistent ratings throughout. Of the list none seems to be overestimated according to the assumed basis of comparison; there being ample margin for 90 per cent efficiency, a lower mean effective pressure and a lower speed than that assumed. But a few approach our so-termed "middle line," leading to the conclusion that there is not the same competitive stress in motors of the higher powers as far as concerns the market, as would be likely in the case of the smaller powers.

As cylinder dimensions increase, it is noted that the margin is still greater, as a rule, due in part to the assumed speed of 1000 revolutions, being out of order with a longer stroke, and in a six-cylinder unit, due attention being given to the sequences of compressions, and other features incident to this combination.

Why Not Establish Standard Factors?

In racing and on "tours" there are a number of methods employed to determine the rating of a car as a whole involving the size of the engine, its speed, the weight of the car, complete, etc. Would it not be a stroke of good business to provide a permanent series of factors, not one which would change from year to year, and present the various cars to the public according to a standard of comparative numbering or lettering, leaving it to the clever designer to work his car into a higher grade by "stealing around the rules" as is attempted in yacht racing.

Few realize that more than $50,000,000 worth of toys have been imported into this country during the last decade. In 1908 the value of toys imported was $7,250,000. Despite this large importation the growth of the production of toys in the United States has been rapid in recent years, increasing from $1,500,000 in 1880 to $5,500,000 in 1905. The growth of toy making in this country has been chiefly in those which could be manufactured by machinery.

Modern Machines for Pipe Threading

Large Pipe Threading Machines Embodying the Latest Improvements and Some Examples of Hand Threading in Inaccessible Places

BY J. F. SPRINGER

The chief fundamental principles which are followed in the construction of numbers of the leading pipe-threading machines are not new. Thus, a hollow spindle, free to rotate but not free to move to and fro, constitutes a feature common to quite a number of machines. Also a die head holding the dies rigidly in position and not free to rotate, but free to slide to and fro on ways, is another feature usually found in combination with the non-sliding spindle. Indeed, these features may be regarded as belonging to the typical apparatus. Apparently all the very largest machines are constructed upon these principles.

The Standard-Wieland Machines

Thus, upon examining the machines built by the Standard Engineering Company, Ellwood City, Penn., it will be found that they do not depart from the regulation type as far as these fundamentals are concerned. They differ, and differ somewhat widely, in certain other details, to which some reference will be made later on. In Fig. 1 is a front view of the largest machine made by this company, which has a capacity enabling it to handle 20-inch pipe. The entire bed, including the bearings for the rotatable spindle, consists of a single casting. This is a construction well deserving of consideration, seeing that it eliminates at once all possibility of loss of alinement between the bearings which carry the spindle. The driving gear is just back of the forward chuck, where it should be to react effectively against the dies. That is to say, this gear should be, as nearly as possible, set up in the pipe by the cutting action of the dies. The operation and speed changes of the spindle are controlled by the levers seen in front. Upon the rear chuck are shown the jaws for gripping the flanges. This enables the fitting of flanges to be accomplished by the machine with the pipe kept clear.

Upon referring to Fig. 2, the gear mechanism is brought into view, through which six changes of speed may be secured. With the exception of the main driving gear back of the forward chuck, all gears are shielded by a guard. The rounding-up blocks are at the left, the upper one being controlled by the wheel at the top of the die bracket. The cutting-off slide disclosed in this view is controlled by a crank, better shown in Fig. 1. The spoked arrangement at the bottom operates the pinion-and-rack mechanism by which the die head with its chasers is fed onto the rotating pipe. So far there is no great novelty in this machine, but the method of operating the dies is worthy of special attention.

In one of Crane Company's machines there is a cam ring and inside it the die holder. The one turns about the other. The apron has been lowered to a horizontal position and lying on it is seen one of the chasers. The cutting end is to the left. At the other end a groove may be observed. When the die is in the die holder, this groove coöperates with a cam rib. It will be readily understood that when the cam ribs are rotated about the die holder clockwise, they will operate to withdraw all the chasers simultaneously from the center. If now the cam ring with its ribs be rotated contrary to the hands of a clock, the dies will all be shoved in toward the center. Now there will be no difficulty in understanding that instead of a groove in the chaser and a cam rib coöperating, there may just as well be a tongue projecting from the chaser and coacting with a cam groove. The result will be the same. In the Standard-Wieland machine, both methods are used in a single case, some of the dies being with projections, the others with grooves. When, in any machine, the cam ring is rotated to its proper position with the dies set at precisely the right distance from the center for the size of the pipe,

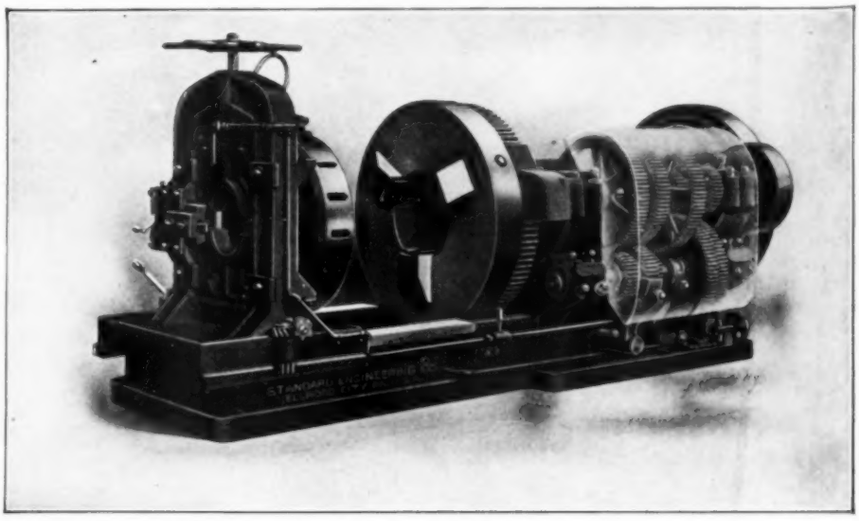


FIG. 2. REAR VIEW OF STANDARD-WIELAND MACHINE, SHOWING GEAR MECHANISM

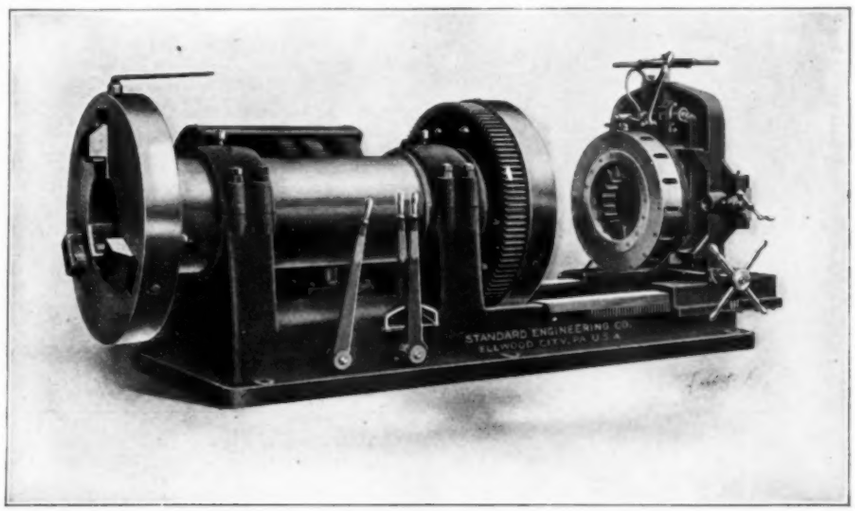


FIG. 1. LARGEST SIZE OF STANDARD-WIELAND MACHINE

it is necessary that the cam ring be secured in order to prevent movement of the dies when the machine is in operation. The method of locking used in this apparatus is very interesting and is covered by patent (1901).

When a locomotive driving wheel is turned by a crank shaft, there are two positions in every rotation called a "dead center." The movement of the piston rod is forever in a straight line. The pivot connecting the crank with the wheel is

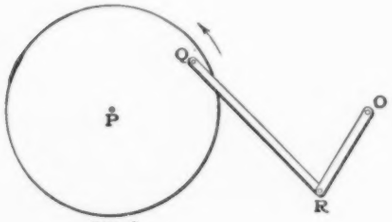


FIG. 3

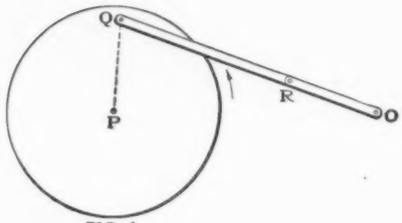


FIG. 4

compelled to move around in a circle. Everywhere the movement of the piston rod will exert a turning effect on the wheel, except when the pivots are both in line with the center of the wheel. If the wheel should come to a stop at either of the two possible positions, no forward or backward effort of the piston rod, however powerful, would turn the wheel. But the wheel can always move the piston, so that, if the wheel is driven, there is no dead center. But take the case where both pivots are compelled to move in circles. In Fig. 3 the two pivots Q and R must move in circles about their respective centers P and O. An entire rotation cannot be made. When Q gets to the position shown in Fig. 4, where O, R and Q are all in a straight line, then if OQP is a right angle, no turning effort of the wheel will result in any motion at all. The wheel cannot move counterclockwise, because such a movement will require the distance from O to Q to be increased, which is impossible. The wheel cannot move clockwise, because such an effort is exerted, and must be exerted, perpendicularly to PQ, that is, along QR. Such an effort will have no tendency to turn R about O as a center. In Fig. 5, where the angle RQP is not a right angle, motion counterclockwise is prohibited as before. An effort clockwise will be more successful, for such an effort will move Q in the direction of the arrow and will break the straight line QRO. However, if the angle RQP is not much removed from a right angle, a very little resistance will prevent this movement. Friction, or friction and a little weight, will be sufficient. The novel locking device of the Standard-Wieland machine depends upon principles of the kind described.

There is a lever A, Fig. 6, which has for the time being a fixed fulcrum or pivot B. The part D is secured to the cam ring, and so moves about a center E. The link DC is pivoted at D and C. If the

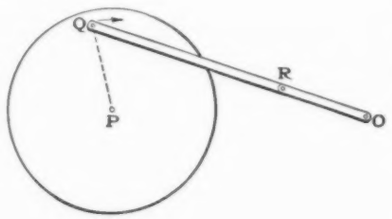


FIG. 5

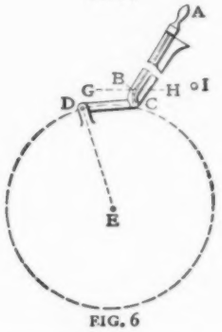


FIG. 6

Power, N.Y.

lever A be moved clockwise, the cam ring will be rotated counterclockwise. And if then the lever be brought back to its original position, the cam ring will be rotated in a reverse direction. These movements of the lever expand and contract the dies. But A may be depressed to the point where B, C and D will lie in a straight line. As the angle EDC will not vary much from a right angle, the cam ring will be locked—not against the lever, but against any action or reaction set up by cutting the threads on the pipe. Now the locking occurs when B, C and D are in a straight line. Consequently, in order that the machine may be adapted to cutting threads on various sizes of pipe, a change of conditions must be possible. This is effected by adjusting the fulcrum B along a horizontal line GH. Every position of B means a different expansion of the dies when locked. Upon referring to Fig. 1, a thumb screw will be seen near the top of the die-head bracket. By turning this the fulcrum may be adjusted. Once set for a given size of pipe, the movement of the cam lever back and forth has no effect upon it. Consequently, there is no disturbance when the chasers are expanded after a cut to permit movement of the pipe.

Now, of course, it should not be left to the operator to determine the amount of depression of the lever necessary to secure the right line arrangement of the three pivots and consequent locked position of the dies. So a stop I is arranged to care for this automatically. However, when the fulcrum is displaced backward or forward, for the purpose of securing a new cutting gage of the dies, the necessary depression of the lever will vary. In order to secure automatically this variation in depression, the side of the lever which contacts with the stop is given a curved form. By consulting the figure, it will be seen that an adjustment of the fulcrum to the left will have the effect of increasing the distance from the axis of the lever from the stop. The block whose position controls that of the fulcrum pin is firmly clamped when the machine is ready for the threading operation.

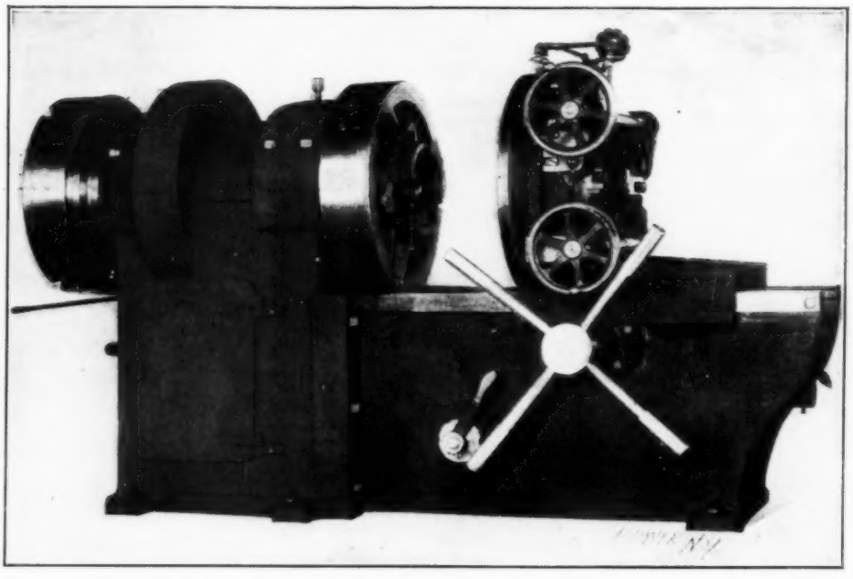


FIG. 7. THE MERRELL PIPE-THREADING MACHINE

It will be noticed that there are radial openings around the rim of the cam ring. Eight of the sixteen openings permit the introduction of dies externally. Eight dies

are introduced from within the die holder. In those positions of the cam ring permitting the placing of the dies in position, opportunity is given by means of the openings to clear all sixteen passageways without removal of the faceplate. Certain dies —all the upper ones and one horizontal— are provided with projections. The others have grooves. None fall out whatever the position of the cam ring. The upper ones are prevented by their location; the lower ones by stops.

Merrell Pipe-threading Machines

A glance at Figs. 7 and 8 will show that the type of machine built by the Merrell Manufacturing Company, Toledo, Ohio, conforms to the usual practice of providing a sliding die-head bracket combined with a nonsliding work-holding spindle. The completeness with which all gears are covered will be noted. The bed is cast in two parts, and the bearings of the spindle are integral with the corresponding portion of the bed. A distinctive feature of this machine is the provision for cutting off pipe by the simultaneous action of tools from two opposite sides, which should effect a considerable saving of time. The rear view, Fig. 8, discloses a telescopic device for the transmission of oil, which is an uptodate and practical feature. The style shown in the figures is that of three sizes of machine having capacities ranging up to 12 inches.

Bignall & Keeler Machines

One of the oldest manufacturers of pipe-threading machines is the Bignall & Keeler Manufacturing Company, Edwardsville, Ill. The fundamental mode of operation of its apparatus is the same as that adopted by a number of manufacturers—the pipe rotates on its axis but is fixed longitudinally, the dies are held in a fixed position relatively to each other, but as a group have a longitudinal motion. In fact, this mode of operation may be said to have become standard, having been adopted by so many makers.

Fig. 9 is a view illustrative of two of the largest machines made by this company. These have capacities of 7- to 16-inch pipe and of 8- to 18-inch pipe, respectively. The great spindle with its two independent jaw chucks for securing the pipe is prominently in view, as are also the arrangements for supporting and rotating it. The advantage of placing the large gear which immediately imparts the drive to the spindle just back of the forward chuck has already been explained. The spoked wheel, seen at the bottom on the right, controls the sliding bracket to which the die holder and cutting-off mechanism are secured. By referring to the rear view, Fig. 10, the cutting-off device may be seen. The holding jaws are controlled by a right- and left-hand screw, seen near the top and controlled by the small handwheel. There is an oil pump located in the bed. The supply is transmitted to the hand by means of a telescoping pipe running along the side of the upper part of the bed. This arrangement does away with a more or less inconvenient length of flexible tubing and yet permits the to-and-fro movement of the head. Referring back to Fig. 9, the hand lever and adjoining mechanism at the top will be noted. These arrangements are for the purpose of controlling the dies and call for some particularity of description.

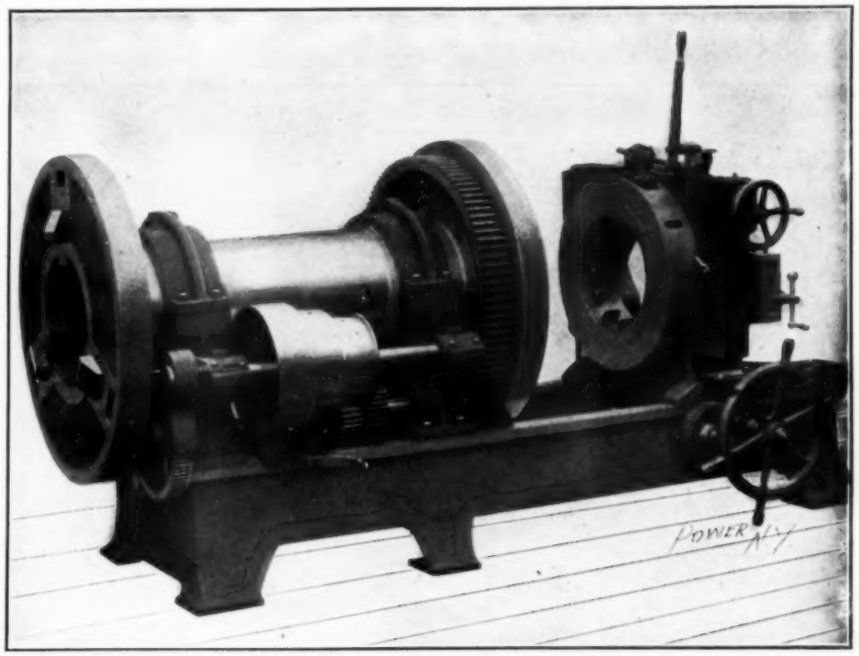


FIG. 9. LARGE BIGNALL & KEELER MACHINE

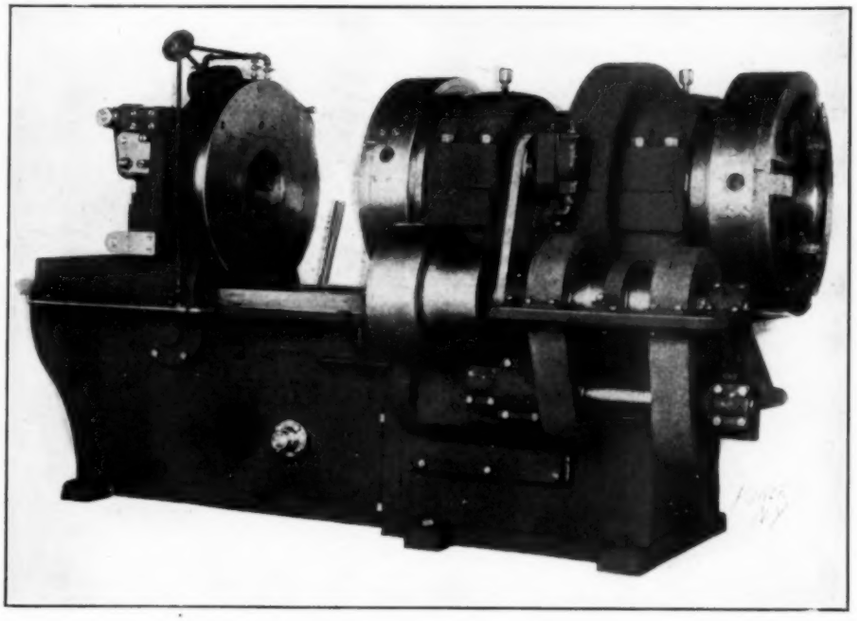


FIG. 8. REAR VIEW OF MERRILL MACHINE

In Fig. 11 are three views showing the Peerless adjusting mechanism, used on the Bignall & Keeler machines, in three different positions. The individual dies are arranged in radial guiding grooves not seen in the views. Their outward and inward movement in these grooves is controlled by a cam ring, the exterior of which is in plain view. Secured to the cam ring and seen at the top is a bracket, and through this bracket passes a threaded rod having one end pivoted to the hand lever. The length of rod between its connection with the lever and the bracket is controlled by the hand nut seen to the left of the bracket. The fulcrum of the lever is arranged on a bracket bolted to the head. In the view at the left, the lever is down in almost a horizontal position and is in line with the threaded rod. Further, the angle made by the axis of this rod with the radius drawn through the center is a right angle, or

nearly so. It will be remembered from an explanation already given, that in consequence of these conditions the cam ring will be locked from rotation. The dies are therefore held in a fixed position suitable for cutting the thread. Although the cam ring is locked from rotation by any movement originating from the dies or itself, the lever is not locked, but may be moved and so rotate the cam ring.

By lifting the outer end of the lever to the position shown in the middle view, the cam ring is given a movement clockwise, which operates to withdraw the dies radially. The work may now be inserted or withdrawn or the cutting-off operation be performed. By swinging the lever a little farther in the same direction to the position shown in the right-hand view, the slots in the cam ring are brought into line with the grooves in the head, when the dies may be slipped out. It will readily be understood, upon considering how nearly alike are the positions of the lever in the two figures at the right, that the latter position must not be allowed to occur through any inadvertence of the operator. Dependence is, however, not put upon his attentiveness. Upon looking closely at the three figures, a pawl will be seen on the main casting of the head. A stop on the rim of the cam ring coöperates with it to limit the expansion of the dies when it is merely desired to remove the work and the like. By throwing the pawl back, however, the position necessary for the removal of the dies may readily be had.

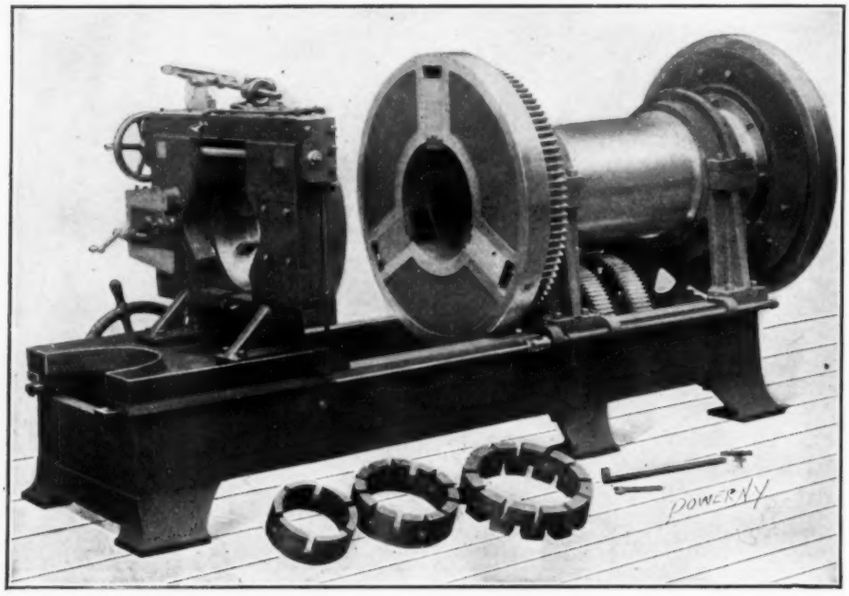


FIG. 10. BIGNALL & KEELER MACHINE FROM THE REAR

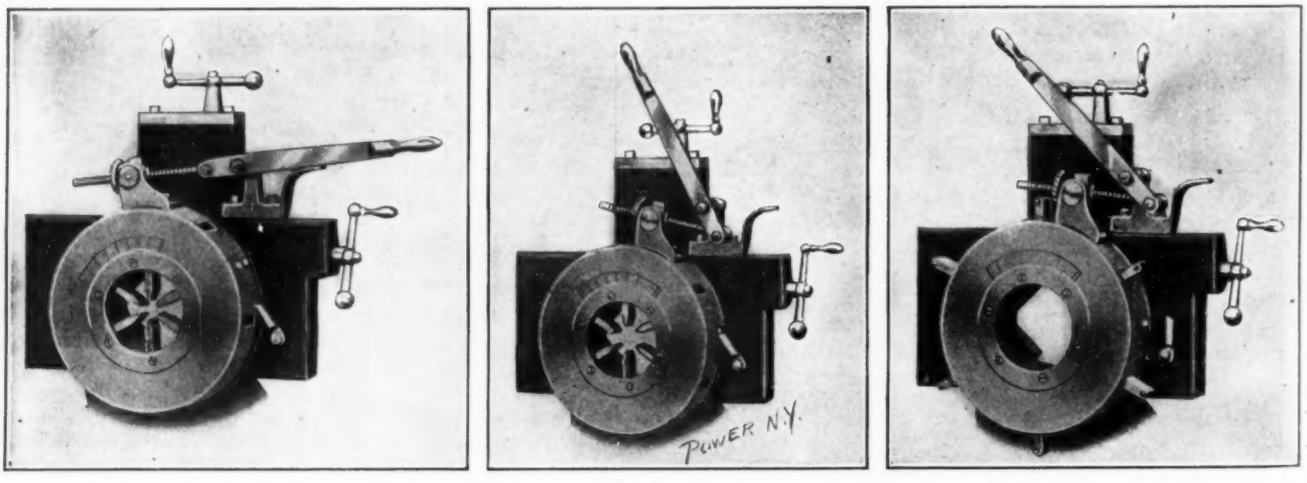


FIG. 11. PEERLESS ADJUSTING MECHANISM

Returning now to the upper view, where the fixed position of the cam ring and dies is shown, it may readily be seen that by adjusting the hand nut the position of the cam ring is altered. That is to say, the cutting gage of the system of dies may be changed. This is of service for three purposes. First, as the dies are used and reground they become shorter and need to be adjusted differently to secure the same cutting gage. Second, expansion and contraction of the dies enable different gages of thread to be cut. This possibility of using the same set of dies for different sizes of pipe would, however, not be possible if the number of threads per inch changed with every gage. In the Briggs standard, the ½- and ¾-inch pipe have precisely the same number of threads, 14 per inch. The sizes from 1 to 2 inches have likewise the same number (11½). From there on, the number remains fixed at eight. The third advantage of being able to adjust the fixed position of the cam ring relates to the desirability, which sometimes occurs, of cutting the thread a little deeper or a little shallower than standard. It is to be observed, however, that such adjustment can be made only within limits, as the variation of the distance between the pivot centers of the end of the lever and of the bracket on the cam ring disturbs the right-angle relationship before referred to and which can only be varied slightly. The possibility of slight variation depends upon friction of the parts.

The Toledo Machines

So far those machines which maintain the chasers fixed radially in the die head during the operation of cutting the thread have been considered exclusively. In all these machines the full length of thread is on the dies, and necessarily so. In any machine, and irrespective of the manner of securing the taper thread, there must be a longitudinal movement relative to the die head and work, and a rotational movement relative to these same elements. Rotation is necessary between dies and work in order to cut. A reciprocatory movement is necessary to provide for the progress of the operation. But these movements are susceptible of accomplishment in a variety of ways. And they have been variously accomplished in actual practice. In the Loew machines and in one type of the Crane devices, reciprocation between die head and work is secured by advancing the work itself along the

axis of the machine. In the Curtis, one type of the Crane, and nearly all other styles, the die head itself advances on the work. Relative rotation is secured in the Loew and Curtis and one or two other machines by revolving the die head. But up to the present point all the machines described have agreed in this—the dies remain fixed in the die holder during operation.

The machines of the Toledo Pipe Threading Machine Company automatically expand the chasing tools during operation. It is thus that the taper is secured. This method is of recent date, the United States patent having been issued in 1904. As the taper is not secured by the tapering of the face of the chasing tool, but by its radial withdrawal, it is consequently possible to reduce the length of the cutting face to any convenient length—a mere thread or two. The cutting V runs over practically the whole of the thread groove throughout its spiral winding on the pipe from beginning to end. This is not the case at all with the fixed chaser. It has not only a separate V for every loop of groove along the whole distance threaded, but several of them. When the operation is just finishing, all the V's are working at once, with the result that a slight bur may be left at the point where each ceases working. The Toledo device effectually meets this difficulty. Further, in the matter of lubrication, it is quite evident that a short cutting face is much more easily cared for than a long one.

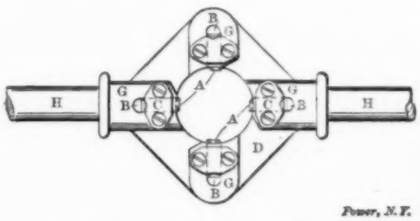


FIG. 12. VOSPER DIE STOCK FOR CUTTING TAPER THREADS

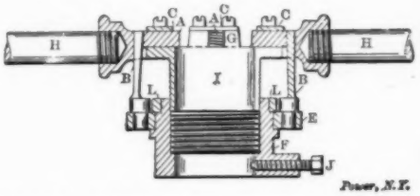


FIG. 13. LONGITUDINAL SECTION THROUGH VOSPER DIE STOCK

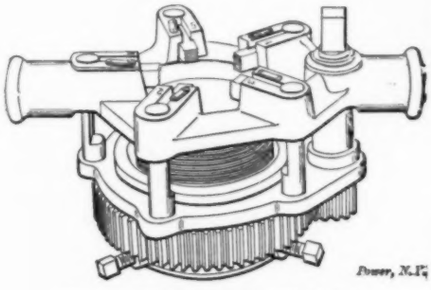


FIG. 14. TOLEDO PIPE THREADER

Let us now consider the mode of operation of this distinct device. The principles are well shown in Figs. 12 and 13, the original patent office drawings, although some deviations in construction have, as is usually the case, been adopted in practice. In the front elevation, Fig. 12, *D* represents the die holder, *G* being guides integral with it. In these guides, the chasing tools *A* are free to move radially. The clamps *B* complete the guiding arrangements. It will be seen that two of the guides are prolonged and arranged to receive the spokes or levers *H*. This arrangement may be well seen in Fig. 13, which is a longitudinal section through two of the chasers and the operating handles *H*. The head is extended at *I* in the form of a tube exteriorly threaded.

FIG. 15. THREADING A WELL PIPE

A device *F*, for holding the pipe to be threaded, is provided with one or more set screws *J*, and is interiorly threaded to receive the exteriorly threaded portion *I*. It will now be seen that both the rotational and the reciprocatory movements of the dies and the pipe may be obtained by simply operating the levers *H*. As the longitudinal movement of the dies is precisely in accordance with the thread of the engagement between the die holder and the pipe holder, it will be seen that this thread must have exactly the pitch which it is desired to cut upon the pipe. At first, it might be thought that this requirement would operate to limit the use of a single machine very greatly. But upon referring to the standard specifications, it will be found that the pitch for all sizes from 1 to 2 inches inclusive, is precisely the same, namely that of 11½ threads per inch, and that beginning with 2½ inches and on up to 18 inches the pitch is uniformly that of 8 threads per inch. The provision for expanding the dies remains to be explained.

Back of each tool the die holder is pierced and a movable pin arranged in the hole. This pin receives the thrust of the die during the progress of the work. By suitably tapering the contacting surfaces of pin and chaser, the latter may be permitted to recede radially by simply pushing the pin up through the hole. In Fig. 13, these pins are represented by *B*. Their rear surfaces where they contact with the die holders are parallel with the axis of the pipe. Their forward surfaces, as also the contacting surfaces of the chasers, are tapered 1 to 32. The lower ends of these pins are arranged in holes in a ring *E*. This ring is arranged so as to be free to revolve between the flange *K* and a threaded sleeve *L*. The pins *B* have a shoulder which prevents them from passing through the holes in the ring *E*. It will be observed now that, as the die holder, together with its dies, is drawn toward the pipe holder by the operation of the levers *H*, the pins *B* will be pushed upward, permitting radial recession of the chasing tools. It is not difficult to see, then, that with the pipe held in the holder *F*, the operation of the die holder will carry the pins *B* and the ring *E* with it. The pins will not only revolve but project more and more above the die holder.

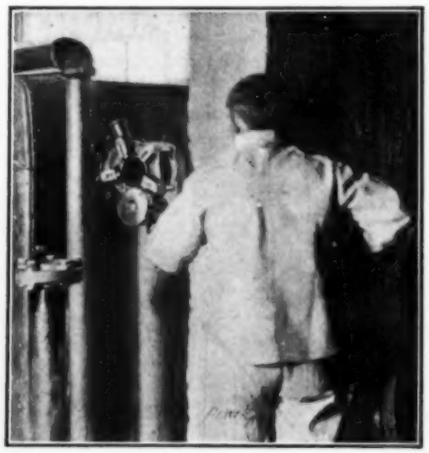


FIG. 16. IN CLOSE QUARTERS

FIG. 17. THREADING A PIPE NEAR THE CEILING

The pressure of the pipe will cause the dies to press against the pins. The result will be that a thread will be cut of the required pitch and having the taper of 1 to 32 relative to the axis.

In Fig. 14 is an example of Toledo construction. This is a machine having a capacity of 2½ to 4 inches. There are five chasers. The sockets for operating levers are seen at either side. A further means of operating this device is through the gear and pinion. The gear constitutes part of the pipe holder. By operating the square end of the pinion by means of a ratchet handle, as in Fig. 15, the pipe holder will be revolved relatively to the die holder and the ring *E*, Fig. 13. The tapered pins, five in number, may be seen in Fig. 14, and below the dies the downward-projecting tubular portion of the die holder, smooth within and threaded without.

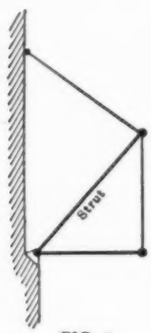


FIG. 1

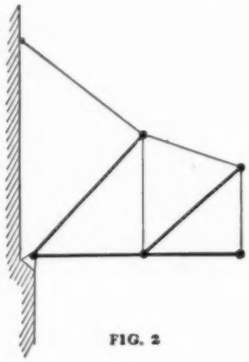


FIG. 2

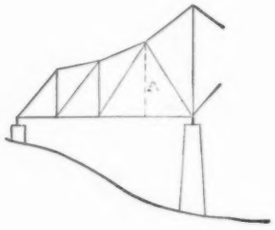


FIG. 4

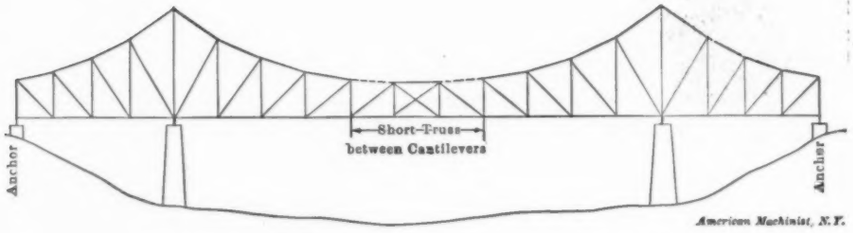


FIG. 3. DIAGRAMS ILLUSTRATING TRUSSED CONSTRUCTION

The device is strictly portable, and the 4½- to 8-inch machine weighs but 155 pounds, while the largest size made, threading 9-, 10- and 12-inch pipe, only weighs 225 pounds. Capacities run from 1- to 12-inch pipe. It will be noticed that the narrow cutting tools are on the outside. This permits of easy lubrication and removal of chips. Apparently no power-driven machines of this type have as yet been constructed.

If it is desired to cut a thread with a slightly larger diameter at the beginning, this may readily be done by operating the machine for a suitable number of turns before inserting the pipe. For an undersized thread, the operation is the reverse. Screw the machine onto the end of the pipe before permitting the recession of the dies to begin. This may be done by simply omitting to secure the pipe in the holder. When the required number of turns has been made, screw up the set screws to hold the pipe, when the tapering action will at once begin.

The illustrations, Figs. 15, 16 and 17, manifest very clearly the readiness with which pipe may be threaded in almost any situation. Practically any place where there is room for the machine itself will be a possible location, for the ratchet handle requires but little space for its operation.

The Simplicity of Trussed Constructions

By Cantlever

An intelligent child of four years can be taught to read and write, and yet many adults lack this knowledge solely on account of their being unaware of how easily they might attain it. For the same reason many good mechanics remain in ignorance of the principles of truss and bridge work, and feel troubled at their failure to understand some of these stupendous monuments of engineering skill, never realizing that all such knowledge is to be found by those who seek it. Workmen often both plan and erect the simpler forms of braced or trussed structures without being oppressed by their mystery, and also without realizing that important erections have the same fundamental laws underlying their design.

A glance at Fig. 1 will show that the tendency for the strut to rotate around the pin at its base is resisted by the inclined rod and that a tensile stress is developed in the latter. It is plain that a chain or rope will resist this stress, and, therefore, it is tension and nothing else. It is not quite so plain, but it is just as true that the resulting stress in the strut is purely compressive. This must be so as the force is applied by a flexible member to a pin at the top of the strut, and bending in the latter cannot result.

Clearly, also, there is pure tension in the vertical rod which supports the outer end of the horizontal member, and in the latter there is neither tension nor compression. The basic principle of all truss work is to so dispose the various members that the resulting stress in each will be only either simple tension or compression—this must be the case when all joints are pin connections—and then the members may be made of form and size to offer the required resistance. The design of the structure must also be such that it cannot change its shape without producing either tension or compression in some of its members. This result is attained by making it consist of a series of triangles, since a triangle cannot alter its shape without changing the length of one of its sides.

All members other than vertical ones are subject to bending due to their own weight, and when this becomes excessive, or when extraneous loads produce bending, special means must be devised to resist it, but this has nothing to do with the truss construction.

Fig. 1 shows the first panel of a cantilever truss. Fig. 2 is evidently the same with another panel in every way similar added to it and now there is direct compression in the horizontal member of the first panel. This process may be continued until the weight of the structure overtaxes the strength of the material of which it is composed.

Trusses of this kind are built out from each side of a river and, being self-supporting as they are built, can be constructed without falsework beneath them. As they approach each other closely, they are connected by a short independent truss. Cantilever trusses are also built shoreward from the bridge piers and anchored to the earth, as shown in Fig. 3, and the much noted cantilever bridge is formed. These shore anchors must be sufficiently strong to resist the reaction produced by a load upon the bridge. The dotted lines in Fig. 3 are not part of the truss proper, but indicate members introduced to give rigidity to the structure.

These diagrams have been kept as simple as possible to serve as illustrations, but changes may be made without affecting the principle. Many of the inclined members are frequently made to slope in the opposite direction from that shown. This has been done in Fig. 4, with the result that the end truss is composed of two less members than Fig. 3. The vertical member *A*, Fig. 4, is also eliminated as part of the truss proper, but is retained as a suspender to prevent bending in the lower chord which, without it, would require to be a stiff member for two panel lengths.

Practical Letters from Our Readers

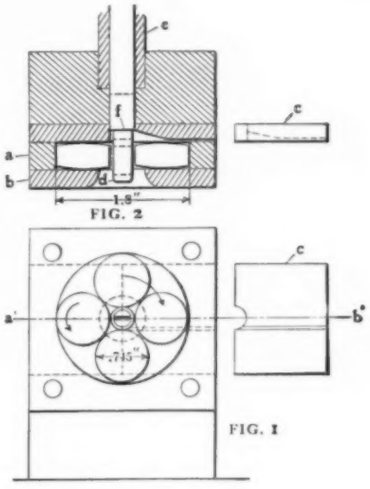
A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

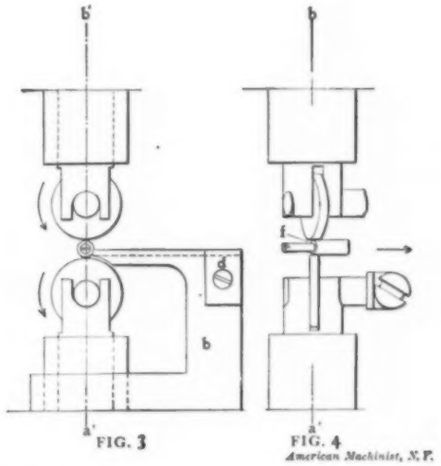
WE PAY FOR USEFUL IDEAS

Making Shells in the Turret Lathe

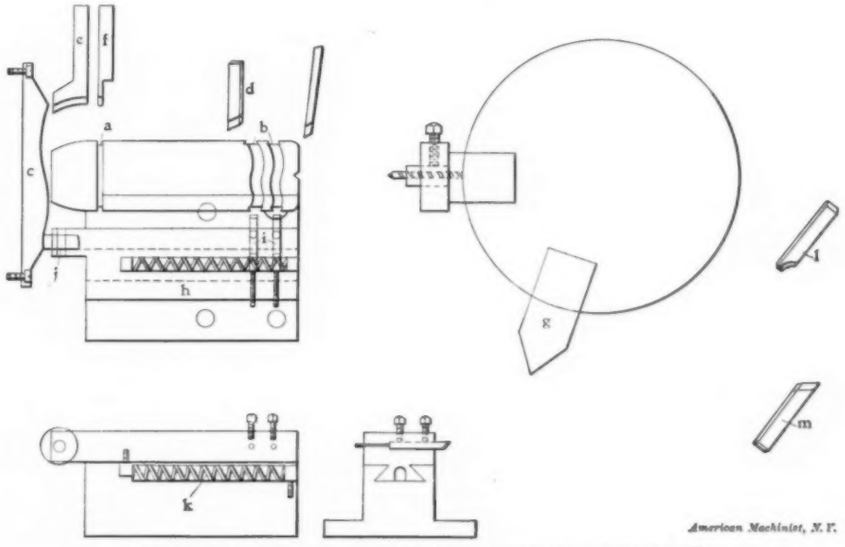
The accompanying illustration shows a set of tools for machining a shell in a Potter & Johnston "manufacturing automatic." The shell is grooved at *a* and *b*, a cam ring *c* being fastened onto the chuck for forming grooves *b*. The cam, or forming ring *c* acts upon a cam roll mounted on a stud in the slide block of the front cross slide. At the right-hand end of this slot are the two adjustable tools for cutting grooves *b*.

The shell is held by a special arbor fastened to the nose of the spindle. The first tool to operate is a rough turning tool *d*, which is fastened in a stem in the turret. When this tool has reached a point almost up to groove *a*, the cross-slide tools *e* and *f* begin to operate and the drill in the turret forms a center to receive the plug center *g*. When these tools have done their work, the turret is revolved and center *g* is brought into position; the slide block *h* is then operated. The cross slide is operated by special cams on the drums. While the tools *i* are being fed in to the required depth, the roll *j* is running on the forming ring or cam *c*, giving the proper form to the wave groove *b* in the shell, the spring *p* being strong enough to cause the sliding block to follow the exact outline of the forming ring.





A SPRING-WINDING RIG



MACHINING SHELLS IN THE "MANUFACTURING AUTOMATIC"

The grooves *b* in the shell are formed dovetailed, and the cutters are the same shape; to give the proper angle the ring *c* is made so that the deeper the tools go, the more of a dovetail is formed. The forming ring is made to taper down in the hollow part and taper just the opposite way on the high portion. When the tools have finished operating and the cross slide is moved backward the tools gradually work to the center of the grooves so that the corners of the dovetail will not be cut away. When this operation is finished, the turret is withdrawn at the same time as the cross slide and revolved again to bring the chamfering cutters *l* and the finish-turning cutters *m* in position to finish the outside diameter of the shell and also round the corners.

Providence, R. I. A. B. MANN

A Spring Winding Rig

I was required to develop a machine for winding initial tension springs from music wire—such as are used in the mechanism of cash registers. The action was to be continuous for a coil of wire and the initial tension was to be the maximum obtainable.

Early in the investigation I proposed to use four rollers grouped in an annular ring about a central arbor. The wire was to be coiled about the revolving arbor by the free action of the roller, 0.0001 to 0.0002 inch being allowed on a side for compression of the wire. At first sight this would appear to be an inflexible construction. But, as it was only required to duplicate a determined number of standard spring sizes, these could be arranged in groups each having its own ring and set of rollers of proper size with which could be used a number of arbors to suit the different gages of wire.

I worked this idea out to the dimensions shown in Figs. 1 and 2. All working parts were hardened and ground tool steel, and the arbors and rollers were lapped perfectly straight. The roller race *a* and cover plate *b* were located on an upright over a horizontal recess cut in it. In this recess were fitted right- and left-hand pieces. The right-hand one is shown removed at *c* and is different from the left

by having a saw cut in it to the depth shown. This acts as a guide for the wire. Removing this piece and withdrawing the arbor to the position shown by dotted lines allowed the wire to be inserted in the slot at *d*. The arbor was then revolved until it was drawn forward to the running position and locked to the hollow spindle *c*. The guide was next replaced with the wire in its groove.

The operation of this machine was very unsatisfactory. For wire above 0.026 inch the coiling would proceed all right, but an excessive pressing action on the inner side caused the spring to expand to double size on leaving the arbor. It will be seen that lateral movement of the spring was induced by the wedging action of the entering wire between the shoulder at *f* on the arbor and the adjacent coil. It was at this point that cutting and breakage occurred on sizes under 0.026 inch.

This construction was abandoned for the one shown at Figs. 3 and 4. Only two rollers were retained and these were narrowed to ⅛ inch and were formed in one piece with their supporting journals. The rollers are adjustable to and from the arbor and about the axis *A'* and *B'* and are driven through universal joints. The arbor also is positively driven at a surface speed approximately that of the rollers. At *B* in Fig. 3 is a wire guide which has about 35 degrees of adjustment about the axis *A' B'*. It has a slot for the wire and a slight tension is obtained by a fiber block.

Fig. 4 is a view of an angle corresponding to one position of the wire guide (removed). It will be seen that the lower roll is parallel to the entering wire and is negative to the lead of the spring, while its mate is adjusted to correspond to this lead.

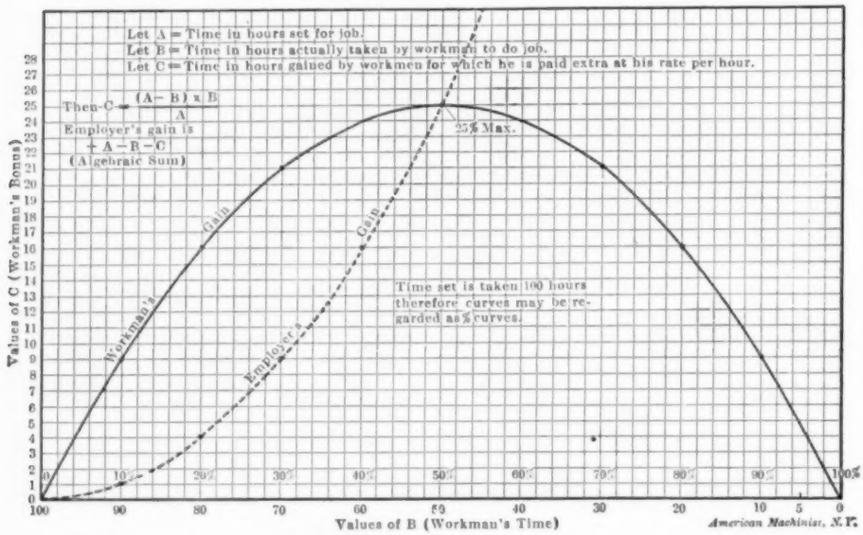
The shoulder on the arbor at *f*, which is somewhat less than the diameter of wire being wound, brought in between the rollers to a point where the line *A' B'* will pass through the center of the turn of wire lying against it. The thrust on the arbor is in the direction of the arrow.

The results obtained with this machine left nothing to be desired. The screws (not shown) that adjust the rollers to the spring bear directly on the plungers that support the rollers, there being no cushioning material between.

Dayton, Ohio. M. F. BATES.

An English Premium System

It is perhaps not generally known that on the close of the big strike of the A. S. E. in England about 10 years ago, it was resolved to adopt the premium system illustrated by inclosed chart.


Let A = Time in hours set for job.
Let B = Time in hours actually taken by workman to do job.
Let C = Time in hours gained by workmen for which he is paid extra at his rate per hour.
Then C = (A − B) × B / A
Employer's gain is
+ A − B − C
(Algebraic Sum)
25% Max.
Gain
Gain
Workman's
Employer's
Time set is taken 100 hours therefore curves may be regarded as % curves.
Values of C (Workman's Bonus)
Values of B (Workman's Time)
American Machinist, N.Y.

AN ENGLISH PREMIUM SYSTEM

While this scheme, for obvious reasons, would not meet the requirements of firms doing repetition work of purely standard type, yet for concerns where large series of similar machines is the exception, the type of premium system offers considerable advantages.

1. Exact time limits are not necessary, and a manager on instituting the system can conscientiously give his promise that no rates once fixed should be cut without the workman's signed consent.

2. The rate fixer does not have to translate the time allowances into dollars and cents. He may be altogether ignorant of the man's rating—knowing merely the capacity of the machine tool.

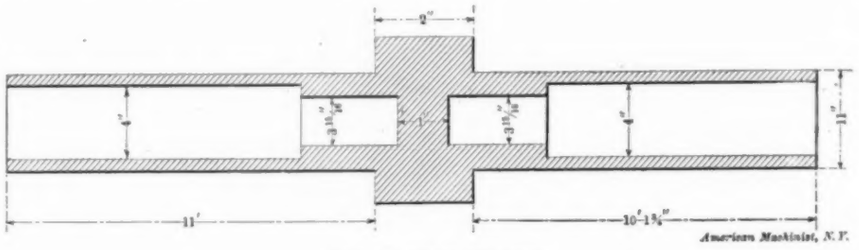
3. No matter how over-estimated an operation may be, the workman cannot make more than 25 per cent. on fixed time and will probably make less.

It is also very easy to establish the amount gained by a man.

Paris, France. C. V. RAPER.

How Would You Do This Job of Deep Boring?

We have a shaft as shown in section in the line cut to turn and bore in the 36-inch lathe. I would like to know what kind of drills, cutters or boring bar to use for this work and also some tool or gage to obtain the size of the hole at the bottom. The sizing of this part is very necessary as a tight-fitting bush goes in the bottom of the bore.

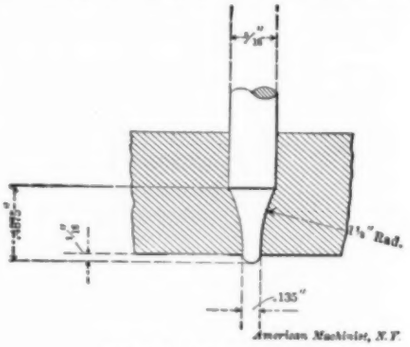


THE SHAFT TO BE BORED

Philadelphia, Penn. M. J. W.

Making an Accurate Pin

The sketch shows a pin and its chamber, and I would like to get the opinion of practical mechanics as to the advisability of manufacturing in large quantities. This pin as shown must project through the hole 1/16 inch at the small end. It is driven by a sharp, quick blow and still it must drop back of its own weight. It has been a question in my mind whether this could be manufactured accurately enough so as to give no trouble. So much depends on the tools holding up, as the least variation of the screw machine and counterbore tools would vary the length the pin would project and cause the pin to stick. I should appreciate hearing from authorities on this matter.

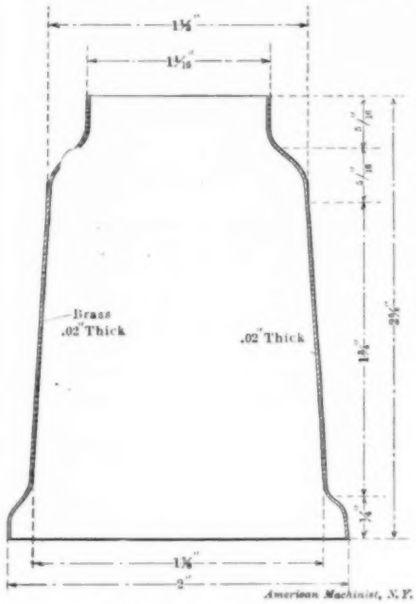


THE PIN AND ITS SEAT

New York City. A. J. JONES.

Dies for Forming Tubes

I would like to submit to the readers of your paper the sketch inclosed and have them offer suggestions and sketches for



THE TUBE TO BE MADE

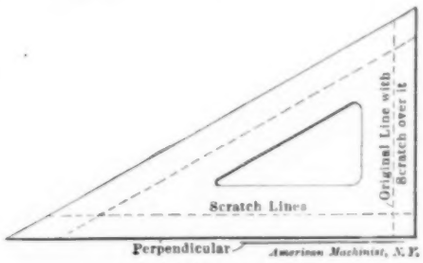
dies to form seamless brass tubes about 0.02 inch thick. It is not necessary that the walls of these tubes be of uniform thickness. The bottom and top are open.

Dubuque, Iowa. A. B. CARD.

A Triangle Kink

Frequently, in making particular sketches on section paper, and otherwise, various angles and parallels are required which are at an angle to the lines of the paper, if there are any. On a sheet of paper not pinned down, the use of a T-square is awkward, so I select a transparent triangle, and mutilate it with scratch lines parallel to the edges, but extending them beyond the points of intersection to the edges.

For perpendiculars the scratch line is



A TRIANGLE KINK

laid on the given line, when the perpendicular is automatically determined by the edge of the triangle. This functions also for parallels, simply by moving the triangle along, using the original line drawn, as before. It is apparent how other angles than 90 degrees may be found, using the other scratches, and working from an existing line. This kink has proved itself a time saver and insures accuracy in the sketches.

Brooklyn, N. Y. A. FOLK.

Fixture for Grinding Formed Cutters

We use for a certain job a gang of three milling cutters as shown in the sketch, the two outside ones having a circular face, the center one an ordinary straight face. Primarily the outside cutters were made to sharpen by grinding on the face of the teeth, but owing to the manner in which they became worn this necessitated too much grinding. The cutters as now used are ground upon the edge in the same way as ordinary cutters but special means had to be adopted so as quickly to obtain the proper curve, the fixture shown being made for this purpose. It will be noticed that the center of the tooth-form circle does not coincide with the center of the cutters but lies ⅛ inch from the inner faces and is for a larger radius.

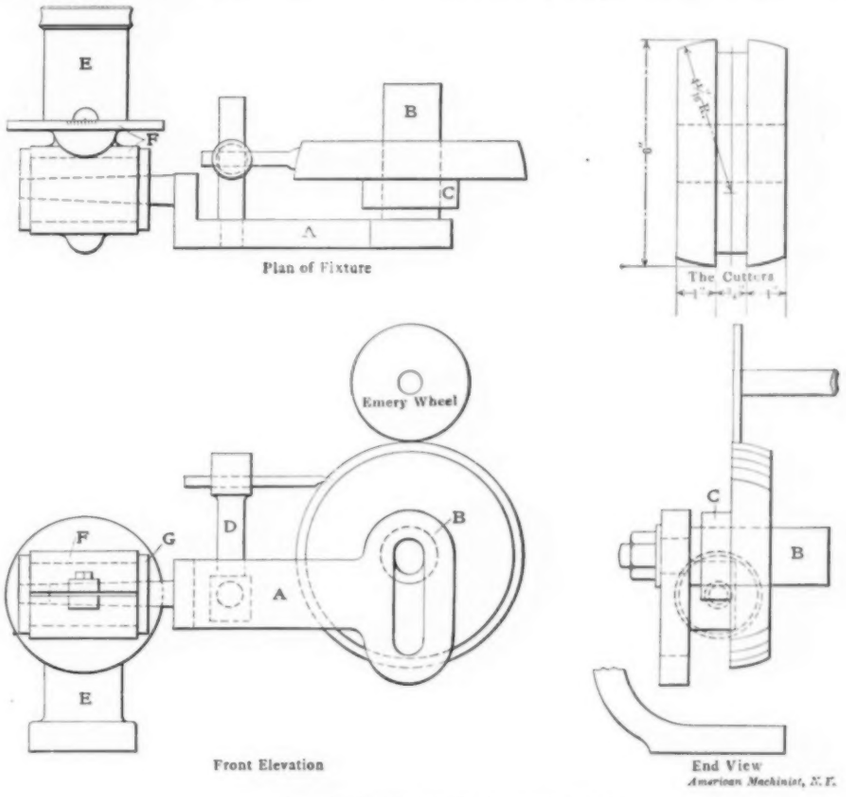
The cutter grinder was already fitted with a universal head *E F G*, having a taper hole into which the mandrels are placed. The bracket *E* is fixed to the table of the machine and carries the graduated portion *F* which can be adjusted by worm and worm wheel to obtain the requisite amount of clearance. Working in *F* is the barrel *G* into which the stem of the fixture is placed and by means of which the fixture and the cutter are given a revolving motion.

The fixture proper consists of a forging *A* having a taper stem at one end and a slot at right angles to its axis at the other. As will be seen from the plan, this slotted portion is offset from the center of the stem and is fitted with a mandrel *B* to carry one cutter. The mandrel can be adjusted in the slot so as to bring the center of the stem and the tooth circle in line and the cutter can be adjusted sideways upon the mandrel by means of collar *C*. An adjustable tooth rest is mounted upon the arm of the fixture, the whole arrangement revolving together.

The views show the emery wheel in position ready to grind a tooth but for the sake of clearness the whole of bracket *E* is not shown in the end view. This fixture can be used for any circular-shaped cutter within its range and is not only applicable to this one job. It might be asked why both cutters are not ground up at the one time, and this could easily be done, but we would have needed a stronger universal head and also the arm of the fixture would have to have a greater offset.

A gage is used during grinding, the three cutters being slipped on a mandrel and tested with it to see that an equal amount is taken off both the outside ones. Of course, the cutter and fixture are only given a rocking motion and do not revolve in a complete circle.

Manchester, England. W. O. HARRAP.



FIXTURE FOR GRINDING FORMED CUTTERS

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

Should Screw Threads Have a 60-degree Angle at Right Angles to the Helix?

The question of the angle of screw threads raised at page 1045, Part 1, by L. D. Dudley, was discussed at page 211, Part 2, by R. K. Melvin, who took the position that the angle of screw threads should be 60 degrees at right angles to the helix, instead of on the line of the axis.

I have awaited with interest some further comment on this question and now write because I do not believe that such a view as that taken by Mr. Melvin should pass unchallenged, it being contrary to general practice and, while having a theoretical argument in its favor, has all practical considerations against it. This is not a new question, it having been ably discussed in the AMERICAN MACHINIST of September 22, 1888, by O. J. Beale, under the name of "Jarno," and by C. A. Smith, under the name of "Pedro," in the issue of October 13, 1888, both of these writers recognizing the theoretical inaccuracy in measuring the screw threads on the line of the axis by the methods described, but taking the position that the angle should nevertheless be made 60 degrees in line with the axis.

Mr. Smith says, "The idea will naturally suggest itself to anyone, that it would be better to measure the angle of the thread in the plane normal to it, instead of the axial plane; then the angle of the thread would always fit the measuring points of the micrometer. This could, of course, be done without any serious change in the axial angle if the normal angle was uniformly made 60 degrees, but it would be too much trouble in ordinary practice to carry out this idea, as the thread tool would have to be ground or set to a different angle for every diameter and pitch. In a shop where a specialty is made of the business, it could be carried out without much trouble, since special tools are usually provided for the different operations; but such practice would only lead to endless trouble and annoyance in every other shop that should make any attempt to use the product of the former."

While not definitely stated in their report it was, without doubt, the intention of the committee of the American Society of Mechanical Engineers to establish their standard screw thread so as to be 60 degrees measured in line with the axis and it would be unfortunate if a variation in practice, even if theoretical only, should be introduced by making it otherwise now that we are on the eve of a greater degree of uniformity in this matter of screw threads.

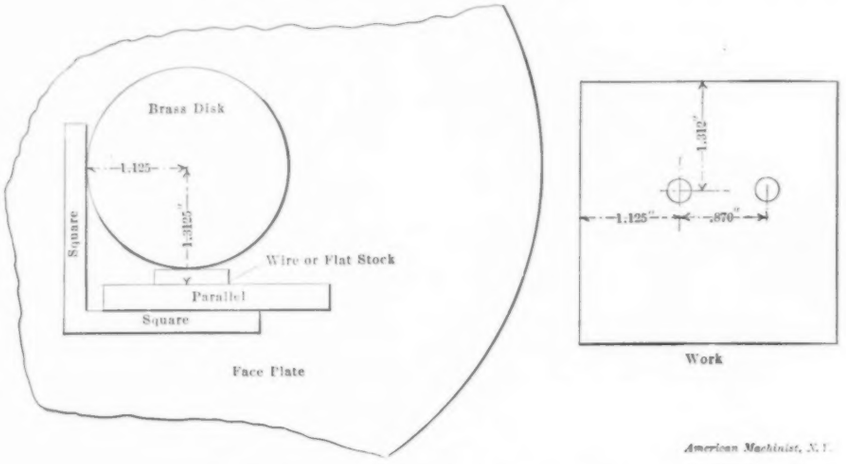
LUTHER D. BURLINGAME.

Providence, R. I.

Toolmaking Accuracy without the Buttons

In response to Mr. Kaup's request for criticism on his method of locating holes published at page 505, I am submitting a sketch illustrating an idea as to how I would locate them. Although his method is interesting and doubtless good results can be obtained by it, it seems to me to be an indirect way. Since local conditions often determine the best way of doing work nothing more in the way of criticism is offered. The inclosed sketch shows the method I have employed on this class of work with good results. The brass disk is soldered on a taper fitted to the lathe spindle. This disk is then turned down to 2.250 inch, its radius measuring off the distance of the hole from one edge. Three-sixteenths is added to this for the other distance, using wire or flat stock, as shown. The parallel and square are then carefully clamped, when the disk is removed. The work is then clamped in contact with the square and parallel and bored. If the square is now loosened and a gage 0.870 inch thick inserted between it and the edge of the work, again clamping the square the work may be moved along the parallel and the other hole located. With close attention given to clamping, as many holes as desired can thus be located with good results.

Elgin, Ill. GUS HESS.



LOCATING WORK ACCURATELY ON THE FACE PLATE

Efficiency of a Duplex Chain Hoist

My attention is called to an article, on page 708 of the AMERICAN MACHINIST, under the title, "Efficiency of a Duplex Chain Hoist," which is utterly wrong and misleading.

We were the original licensees in this country under the patent of Thomas A. Weston, the inventor of the differential pulley block. This article is known by that name throughout the world. Many years later we introduced, with exceptional success, another invention of Mr. Weston's, a geared chain block with an automatic brake, for which we coined and adopted the trade name "Triplex." A few years later we brought out a screw block to which we gave the name "Duplex."

When we introduced the Triplex block we gave wide publicity to tests of its efficiency made by Prof. R. H. Thurston, which showed that its mechanical efficiency was about 79 per cent. as compared with 31 per cent. for the Weston Differential block as made by us, or with about 25 per cent. as compared with the differential blocks of other makers; in other words, that the efficiency of the Triplex block was about three-fold that of the differential block. The efficiency of the Duplex block, as determined later, was about 40 per cent.

The article published by you evidently relates to a differential pulley block, as it states that "the upper pulley has two chain grooves, one having 12 pockets and the other 11," whereas neither the Duplex nor the Triplex block has any such differential sheave. The article implies, however, that the tests which it reports relate to a "duplex or triplex chain hoist." This involves two errors: (1) In the implication that a triplex and duplex block are the same thing, and (2) that the tests reported were made with either.

As the names "Triplex" and "Duplex" are trade names belonging to us, and are registered as such in the United States Patent Office, the article in question tends seriously to our injury, and we will thank you to correct it according to the facts, and to give publicity to the correction equal to that of the erroneous article.

HENRY R. TOWNE,
President Yale & Towne Manufacturing Company.

Use and Abuse of Lathe Chucks

That part of the article at page 565 pertaining to removing a chuck from a lathe by F. Reuter reminds me of a foreman for whom I at one time worked, who used to take particular pains to keep the lathe chucks in good working condition. His ideas in the care of chucks always struck me as being O.K. and are here given with the hope that they may be of service to others.

For instance, in order to remove a chuck from a lathe, and to prevent the chuck jaws from being sprung in doing so, he had a short ⅜-inch hole drilled in the thimble of all chucks, and spanner wrenches made whereby the chucks could be removed without any danger of springing the chuck or breaking a wrench in the manner spoken of by Mr. Reuter.

In order to prevent universal chucks from being sprung out of true he allowed no one to use them for holding rough stock or anything that was out of round or out of square that would tend to spring the jaws out of their proper relation to each other.

Every chuck had a tap to clean out the thread of the thimble. By using the tap all chips and grit were removed at once and the chuck would always screw on the spindle of the lathe the first time; which can not always be said of the other method, so often used, whereby the thimble is cleaned out by a piece of waste wrapped around a file or stick.

Another good idea of his, worthy of mention at this time, was that all wet emery wheels used for grinding lathe and planer tools were not to be used for grinding soft steel or any other kind of soft metal; for the reason that the soft steel would adhere to the emery wheel in such a manner as to greatly lessen its cutting qualities.

Waterbury, Conn. R. CHARLES.

Method of Making Name Plates

Entropy tells on page 641, Vol. 31, Part 2, of a cheap method of making name plates. Here is another way and is that used by many name-plate manufacturers, who turn out their work very cheaply.

A large stock of pattern plates and letters is kept, the plates being of the usual standard shapes and sizes, with standard molding or beading around the edge similar to those shown by sketches, Figs. 1 and 2. The plates are of brass and the figuring or marking, as the case may be,

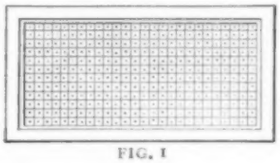


FIG. 1

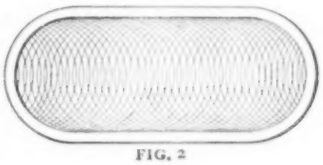


FIG. 2

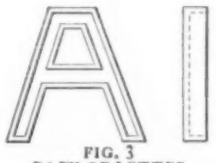


FIG. 3
BACK OF LETTER
American Machinist, N.Y.

BACKGROUNDS AND LETTER FOR NAME PLATES

which forms the ground work is very distinctly cut; but the plates bear no names. In cases where one type of plate is used with varied styles of heading, the pattern plate is made up in such a way that the beading is detachable, so that one style can be readily changed for another. The letters consist of the varied sizes and character of letters and figures which are in demand.

Say an order is received for a standard 6x4-inch rectangular plate, with diamond-shaped background, or ground work, with ½-inch letters. This is sent to a girl who draws the required plate from the store and then proceeds to draw the necessary letters and figures from her type box, which is similar to that used by a compositor in a printing room. These type, however, have a slight draft on them so that they may be easily withdrawn from the sand, and they are hollowed out at the back, similar to sketch, Fig. 3. After applying a little quick-drying paste to the back of the letters and figures, she locates them on the plate and through experience and with the aid of the ground work, this is only a matter of a few minutes.

This plate is then handed to the molder who molds the necessary quantity. After casting he returns the plate to this same girl who lays in a small tank of fairly hot water which dissolves the paste and thus eases off the letters and figures. These go into her type box after being cleaned and the pattern plate to the store.

When the plates are received in the machine shop they are rough and finish ground on the face and edges on a disk grinder, a No. 5 disk being used in the roughing operations and a No. 2 for the finishing. Then, if the order is for a highly finished plate, it is highly finished on a horizontal lead lap using *F F* emery powder after which it is lacquered on the faces of the letters, figures, heading and edges. The whole operation from the time the plate is taken from the store until it is returned is often not more than 15 minutes where the order calls only for one or two plates.

ROBERT BROWN.

Ellasden, Scotland.

Draftsman's Radius and Center Finder

How many good things there are shown up in the AMERICAN MACHINIST that no one makes use of! I am inspired to make this remark by T. S. Quay's center finder, illustrated at page 481. It's a cute thing, and one would think that every draftsman who sees it would sacrifice a piece of tracing cloth two inches square and make himself one the first leisure moment, but he won't. And too, one would think the makers of drafting instruments would jump at the chance for a new thing to put on the market, but they won't. I venture to make these positive assertions from what has gone before.

John Coffin, in 1885, copyrighted his Hyperbola chart, a transparent series of hyperbolas, the same as Mr. Quay's concentric circles, for drawing the clearance lines on indicator cards. He not only never sold any, but couldn't give them away.

Three or four years ago I illustrated one of the handiest little drawing tools I have in my kit, the little rectangle with round corners, for drawing various round corners and fillets. It ought not to cost twenty-five cents, every draftsman would find it immensely useful, but the instrument makers won't make them for the market, and the draftsmen won't make, or get them made, for themselves.

I want to say to Mr. Quay, don't get disheartened; you know just as much after showing it up as you did before, and you may live long enough to see it in use. I am now getting a little consolation out of seeing the seed I sowed 40 years ago beginning to sprout.

Syracuse, N. Y. JOHN E. SWEET.

The Problem of a Vacuum Bottle

After reading C. M. Ripley's amusing article I should like to ask the "Vac. Expert" at which *temperatures* liquids can be kept hot for one day and cold for three days, and how much the temperatures have fallen or risen after the respective lapses of time. Only in the knowledge of these particulars an exact answer can be given. Nevertheless, I shall try to give an explanation of this puzzling bottle. Let the extreme temperatures of water, for instance, be 200 degrees Fahrenheit when near boiling and 15 degrees Fahrenheit in a frozen condition and the temperature of the surrounding air 60 degrees Fahrenheit. Consequently there is an interval from 15 to 60 = 45 degrees Fahrenheit, and from 60 to 200 = 140 degrees Fahrenheit, and the distance in degrees Fahrenheit from 15 to 60 degrees for cold, therefore, is about one-third of 60 to 200 degrees for heat.

Now, I have to express my opinion that the "Vac. Expert" was talking nonsense to the "Inq. Caller" by telling him cold is traveling. I rather think the "I. C." was on the right way to get behind the puzzle when he said "cold is simply the absence of heat." Of course, something which is absent cannot travel at all. A comparison with compressed and evacuated air would have given the explanation at once. Instead of giving the above figures the signs of degrees Fahrenheit they can be taken as pressure in pounds per square inch. The air could not pass the walls of the bottle but in its stopper a hole could be made which allows the air pressure to fall and rise in just the same way that heat does. The opening, therefore, is the equivalent of the heat-transmitting surface. The surrounding air would have then a pressure of 60 pounds, and it will be evident that if the inside of the bottle is under a pressure of 200 pounds the outflow is about three times as fast in the unit of time as the inflow when the bottle is only under a pressure of 15 pounds. I think this will explain the faster traveling of the heat from the inside to the outside than in the reversed direction.

Yet there is another fact which under the above circumstances would let out heat easier than in. If the surplus of heat is inside of the bottle its outside surface is radiating, and if a minimum of heat is inside the inside surface only, which is smaller, transmits the heat to the inner medium. If, therefore, the vacuum space of such a bottle is very wide the inside surface will be accordingly smaller than the outside one, and heat will travel under the same difference of temperature from the inside to the outside at the rate

$$\frac{\text{outside surface}}{\text{inside surface}}$$

faster than *vice versa*.

CONRAD DEUTSCH.

Winterthur, Switzerland.

Unnecessary Accuracy

The editorial on page 377, Volume 32, Part, 2, caught my eye just when I had seen one of the finest exhibitions of unnecessary accuracy that it is possible to imagine. A pair of jigs were required as shown in Fig. 1, *A* and *B*, and as they were subject to an independent examination after leaving the tool room, and the drawing gave no limits, they were made as close as it is possible to make a jig of this size.

The bushings were 1-inch diameter

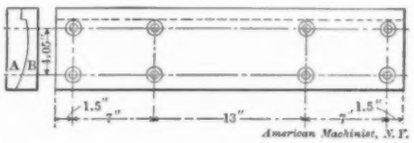


FIG. 1. AN EXAMPLE OF UNNECESSARY ACCURACY

holes in open jig and 1-inch tapping holes in the other, and when finished, 8 accurate double plugs went in the holes as the jigs are shown in Fig. 1, and, also when back to back and end for end, and 4 plugs were inserted in the holes when the jigs were half on each other. The final test in the tool room was to insert 4 plugs in each row and try by the straight-edge and as this was found correct, jig *B* was passed on by itself for independent examination.

Fig. 2 is a diagram of the errors he found. (?) It might be stated here that the examiner was equipped with a set of Johansson (Swedish) gages, the accuracy of which is beyond dispute, but the proper place for these gages is the gage room, and their legitimate purpose is for reference. The examiner apparently pushed as many gages in between two plugs as possible and it was no wonder that, although the overall length of the jig was correct, the sum of the distances between

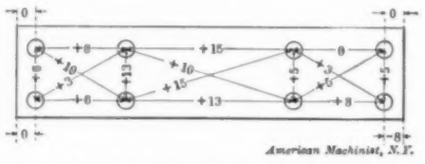


FIG. 2. DIAGRAM OF SUPPOSED ERRORS

the holes exceeded this. It will also be noticed that there is in the diagram of supposed errors, several mathematical impossibilities, the errors as shown in the diagonals, being impossible. The whole thing borders on the ridiculous; here we are talking to the fourth place in decimals when our methods often only approximate to the third place. The errors in the diagram are given in 1/10,000 parts of an inch.

On page 433, W. D. Forbes, writing as to the accuracy of the machinist of today, says: "It is only to be expected that this advance in accuracy will go on until the question of atmospheric conditions will be the determining factor in keeping to standard." Well, this point has apparently been reached, for taking the variation of temperature of an English summer, 40 degrees Fahrenheit, and 20 degrees as the mean, and applying it to the case above, we get for the distance between the center holes variation = 0.0000067 × 20 × 20 × 13 = 0.0017, or, in terms similar to the diagram, 17. Thus, with a drop of temperature of 20 degrees, supposing the errors had existed, the jig would be right.

Now let us consider the work one of these jigs had to do. It was for drilling a manganese-bronze bracket, and if we consider any group of 4 holes to be drilled, then the rise in temperature of the material during the drilling, at a very low estimate, would be 30 degrees, and taking the distance between holes as 7 inches, the probable difference between work and jig at normal temperature would be difference = 0.00001 × 7 × 30 = 0.002 inch.

This all goes to show that limits (in the widest meaning of the term) should be used, and this should also apply to jigs and gages, because, otherwise a huge amount of waste takes place; more especially is this so when the articles are subject to independent examination.

All toolmakers know that it is fairly simple to get a jig within 0.001 of a dimension, but for finer limits the cost runs up rapidly, and this brings me to my last point (and this must be whispered in case the 1/10,000 part of an inch brigade should hear it), not one drilling jig in one hundred need be nearer than 0.001 of an inch of the drawing dimensions, i.e., plus or minus 0.0005 may be allowed on them between holes, and twice this amount when the jig is of any size.

WALTER G. GROOCOCK.

Woolwich, Eng.

A Curious Power Drive

When arriving at his conclusion on the economy of the group drive in the shop he describes at page 486, Du Pont evidently loses sight of the fact that it is not the aggregate horsepower installed, but the cost per unit length of time to operate the shop under the new conditions, as compared with the engine drive, that tells the story. Let him take his power bill for a month and divide it by the cost per horsepower-hour and this result by the number of working hours. He will then obtain a very fair approximation of his average load which, with a well laid-out drive, should be considerably less than that previously indicated by his engine.

In proof of this numerous tests demonstrated that the maximum power demand of an installation consisting of several motors is about 50 to 55 per cent. of the total horsepower of motors in operation.

The average demand is only 25 per cent. A fair general average upon which to estimate operating costs might, therefore, be 33⅓ per cent. of the total horsepower installed, and estimates of the cost of operation can be made in an average installation upon this basis.

Taking the 110 horsepower installed and using the before-mentioned data the results look very plausible, as compared with his experience with the engine: Maximum demand average 52½ per cent., 57.75 horsepower; average demand low 25 per cent., 27.50 horsepower; average demand fair 33⅓ per cent., 36.66 horsepower.

The increased production which Du Pont credits to "better facilities for handling" is a result usually of the group or individual drive, as the elimination of belts crossways of the shop allows the use of cranes and other labor-saving devices. The group drive will also effect considerable economy when it is desired to operate only one department overtime.

Planers are often assisted by the use of a flywheel upon the motor shaft, or upon the shaft driving the group. I have seen a plant wherein a 40-horsepower motor was displaced by a 20-horsepower motor equipped with a flywheel and excellent results secured. To secure the best results from the motor drive it is essential that a close study of the problem be made and the tools to be operated in one group be selected judiciously.

HARRY O. ALLEN.

New York City.

Kind of Hardness Measured by the Scleroscope

On page 545, Mr. Lake makes further comments on the scleroscope, and raises several questions of high interest to all metal workers. Some of the problems he brings up are only apparent and are thoroughly understood by many, but not all, while others are real problems and their solution would be of great importance if the rules for understanding them could properly be elicited.

Since I have long been preparing practical data along these lines, and much space would be required to do the subject justice, I do not regard it as wise to go into the matter any further than I have in the "Discussion" columns, and will, therefore, prepare a special article particularly on the problems of cutting metals.

One statement, however, seems to me to be not entirely fair, and that is that "many . . . . do not adopt the scleroscope as one of the standard testing instruments, as too much is claimed for it."

Save for the fact that the Brinnell steel ball flattens out against hardened steel where the scleroscope uses a carefully selected diamond, Professor Turner, whom Mr. Lake quotes, shows that both agree in their results, which are gotten in different ways, although both leave permanent indentations in all the metals tested for hardness.

The peculiar results which Professor Turner obtains by disregarding the makers' directions, and which he suggests may mean a new kind of elastic hardness, are of no practical importance, and are only such as anyone may expect by ignoring the good and costly experience of the manufacturer. Those who have thus used the scleroscope with average fairness find by observing the warnings given by the maker, that it does all and more than is claimed for it.

As a matter of fact, I have withheld many of the data supplied by progressive users in writing on this instrument until the proper time should warrant further claims, and thus avoid the inevitable impression of "too much scleroscope." Like everything which possesses merit, the best friends of the scleroscope are its oldest users, and some have a number in constant use by "scleroscope operators." Sometimes these are girls or boys, especially when many duplicate parts are inspected.

New York. A. F. SHORE.

Cost of United States Patents and Their Value

In the AMERICAN MACHINIST on page 587 E. C. Smith takes exception to Mr. Alford's article on the cost of procuring patents and their commercial values at the time of issue. Mr. Smith's figures do not fairly represent the cost to individuals as they are based on expenses as shown to accrue to a large corporation for such work.

It must be remembered that the corporation employs its own mechanical experts, has at its command the combined thought of trained mechanics (from its manufacturing department) to use as required, also complete files of the sub-classes under consideration, and can thus in a minimum time produce accurate work, clear claims that admit of easy interpretation by the patent office, and at the same time have all work ready for appeals and interferences, which must be anticipated, for the reason that an average amount of revision will always be required. All of these facts demonstrate that the average cost to the individual will be higher than those given by Mr. Smith.

The invitation to all who are not mechanics to step out of the field of invention is not a fair one, and arises, in part, from a failure of the mechanical mind to appreciate the value of the inventor as a pioneer in the field of mechanical progress.

His boundless enthusiasm and indomitable will must ever carry him beyond the safe, tried rules of the mechanic. He will wrestle with the paradox and attempt to force it to do his will in direct apparent violation of mechanical law, many times demonstrating in a crude manner new applications of old laws, thus giving a key by which the mechanic may open new mines of wealth to the manufacturer through his designs, which alone can produce the true and the beautiful in machinery. But it should always be remembered that to the inventor we must look for the crude inceptions on which to build, and realize that it is not in antagonism but in alliance that the inventor and the mechanic must labor, and broadly look forward to the triple alliance of the manufacturer, mechanic and inventor, for their mutual development.

Washington, D. C. O. C. KNIPE.

Limits for Threaded Work—Limit Gage Sizes

We publish below a table of limits for the A. L. A. M. limit gages as made by Wells Brothers Company, Greenfield, Mass., in which table there are a few quantities differing from those given in the table as originally published at page 468. This table of limits as now established by this company should be of interest to users of the A. L. A. M. standard thread.

Plugs.					Templets.			
Size.	Threads per 1".	Thread Mic. Read			Size.	Threads per 1".	Thread Mic. Read		
		Max.	Min.	Diff.			Max.	Min.	Diff.
¼	28	0.2273	0.2264	0.0009	¼	28	0.2259	0.2250	0.0009
5/16	24	0.2810	0.2800	0.0010	5/16	24	0.2794	0.2784	0.0010
⅜	24	0.3437	0.3426	0.0011	⅜	24	0.3419	0.3408	0.0011
7/16	20	0.3938	0.3925	0.0013	7/16	20	0.3918	0.3905	0.0013
½	20	0.4564	0.4550	0.0014	½	20	0.4543	0.4529	0.0014
9/16	18	0.5108	0.5092	0.0016	9/16	18	0.5084	0.5068	0.0016
⅝	18	0.5734	0.5717	0.0017	⅝	18	0.5709	0.5692	0.0017
11/16	16	0.6255	0.6236	0.0019	11/16	16	0.6228	0.6209	0.0019
¾	16	0.6882	0.6862	0.0020	¾	16	0.6853	0.6833	0.0020
13/16	14	0.7999	0.7977	0.0022	13/16	14	0.7968	0.7946	0.0022
1	14	0.9253	0.9228	0.0025	1	14	0.9218	0.9193	0.0025

TABLE OF LIMITS FOR A. L. A. M. GAGES AS MADE BY WELLS BROTHERS COMPANY

It has been estimated that a square foot of uncovered pipe, filled with steam at 100 pounds pressure, will radiate and dissipate in a year the heat obtained by the economic combustion of 308 pounds of coal. Ten square feet of bare pipe corresponds approximately to two tons of coal per annum.

AMERICAN MACHINIST

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November 4	39,750
November 11	19,000

This paper reaches 39,750 *separate readers each month and* 19,000 *each week.*

None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

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The Demand for Better Machine Castings

There is a feeling in many quarters that the average foundry has not kept pace with the other departments of machine construction and many machine-tool builders are beginning to ask whether this condition cannot be greatly improved with a little coöperation.

It is not entirely a question of dollars and cents in the first cost of a casting, for many machine-tool builders and others are getting away from the notion of obtaining work at the lowest market price for castings. They are often willing to pay a good price if they can be sure of getting a good casting, one that is true to pattern, that will require a minimum of machining, that will be close-grained and free from blow holes, and that will present a pleasing appearance to the eye of the customer without an undue amount of labor being spent on filling and painting.

In one foundry we know of they are educating customers away from the "price per pound" and toward the "price per piece." This does away with any inclination to "swell the mold" so as to get in more iron, and the customer knows exactly how much each piece will cost.

In buying bar stock we avoid the mills whose bars run oversize, both on account of the extra weight and the unnecessary machine work that has to be done. The same line of reasoning holds good in machine castings, as the less material that must be removed, within reasonable limits, of course, the less the cost of machining and the easier it is on tools. When castings are uniform the problem of holding in fixtures for the various machine operations is greatly simplified in every way.

The foundry in question also makes machine tools and they report a substantial reduction in the cost of machine work since the introduction of really good castings, which much more than offsets the increased cost of the castings themselves. Then there is the lessened cost of preparing the machines for painting, as they are very particular as to the appearance of their machines and this is more than might be imagined as care is taken to have them appear smooth and symmetrical.

Foundrymen do not usually hail this demand for better castings with unalloyed pleasure, as it often means a reorganization of their foundry and its methods, as well as the training of men in the newer way of having the castings resemble the patterns a little more closely than is sometimes the case. And, where the customer insists on the lowest price he should not expect the best work.

There is need of education both for foundrymen and machine-shop managers along this line, for none can deny the advantages of good castings any more than good machine work. The foundry problem may be to educate molders to closer work just as the machine shop has had to train its men from the 2-foot rule to the micrometer.

It must not be thought that all the advantage consists in the mere appearance of the machine, although this can easily be underestimated, but it also vitally affects portions to be machined and has an important effect on the cost of construction when castings can be made as close to exact duplication as is possible in a well equipped foundry with care in the molding and the metal used.

Unless we are misinformed, the founders of some of the European builders have given this much more attention than we have and are producing castings that are marvels of accuracy and finish. It is one of the live subjects, and, though there are many difficulties in the way, they are by no means insurmountable.

Giving a Patent to the People

A recent article in our columns on the Santos Dumont aëroplane, a dwarf in size compared with most others, states that the inventor has given his patent rights in the machine to the people, and hopes that they will be able to have machines built from his design for a small amount of money.

We do not, of course, know how valuable his patents may be, nor do we know his motive for thus giving his rights to the public. However, his machine is successful, very successful, as a statement that a certain firm is preparing to build a thousand of them during the coming year testifies, and we choose to believe that Monsieur Dumont's gift is in perfect good faith, and springs from his sincere desire to aid the cause of aviation, a cause he has served so well for many years.

Recently the daily press has announced several suits instituted by the Wright Brothers against alleged infringers. These statements have not been entirely without an attempt to depreciate such moves as tending to hold back the cause of aviation in this country.

In this connection we must all fully realize that patent rights in air ships are no different from any other patent rights, and that the Wright Brothers are acting well within their rights in instituting such legal proceedings. What the decisions may be and what influence they may have upon the development of aëronautics, remains for the future to show.

Returning to our text, giving a patent to the people; a patent lawyer suggests that there are two ways in which this might be done in this country if anyone were disposed to make such a gift. By making a formal assignment to the people of the United States and duly registering this assignment in Washington; or by making a formal assignment to a certain

individual as a trustee for the American people, under suitable provision whereby anyone, so desiring, could obtain a license to manufacture under the patent by paying a nominal fee to the trustee for the trouble of making out the necessary papers, or no fee at all as the donor might elect.

We are constantly talking about patent reform and believe that such reform is coming. A point worthy a moment's consideration is this: Why should a patentee who is liberal enough to give his patent rights to the public be compelled to pay the United States Government for granting such a patent? or, in other words, why should not our new patent act, which Congress will probably pass, within a few years at least, determine that a patent which is to be assigned for the benefit of the people of the United States, will be granted without the payment of any government fees whatever?

The Absorbing of an Industry

In 1900 the carriage-making industry of the United States employed 80,000 wage earners and an invested capital of $118,000,000. At the annual meeting of the Carriage Builders' National Association of the United States, held at Washington, its president admitted that the carriage builders the country over must either retire from business or hereafter construct bodies for automobiles. Already several prominent carriage builders have turned their attention to automobile bodies, and a few to producing entire cars. But apparently from this extraordinary confession an entire industry is about to be absorbed by a successful rival.

But a single parallel can be pointed out in industrial history, and here again the surprising fact is that the absorbing industry is the same. We refer, of course, to the absorption of the bicycle industry into the automobile industry in the early days of the latter. The passing of the bicycle factories was recognized by all, but the vanishing of the carriage industry, which is about to take place, has not been generally observed.

And yet this absorption, considerable in extent, affecting many thousand workers and many million dollars of capital, has not caused a ripple on the surface of industrial progress. There may be many reasons for this situation, but it is seen that a carriage joiner can easily turn to fabricating an automobile body; that a carriage upholsterer can employ his skill to advantage in upholstering a limousine, and that the painting and finishing of automobile bodies do not differ essentially from the finishing and painting of carriage bodies.

To all who fear the outcome of events surrounding economic progress we commend this particular industrial development. At the same time owners of existing industries may well ask themselves, "Are we secure in our field of manufacture?"

New Publications

CONCRETE. By John C. Trautwine, Jr., and John C. Trautwine, 3d. 200 4½x7-inch pages; numerous illustrations and charts; thumb indexed; alphabetically indexed. John Wiley & Sons, New York City. Chapman & Hall, Ltd., England. Price, $2 net (8/6 net).

No better proof of the importance of concrete as a material of construction is needed than this engineer's handbook of 200 pages. Although it is a reprint of selected pages from the 1909 edition of "Trautwine Civil Engineer's Pocket Book," yet we are glad to welcome it as the latest engineer's handbook and easily the leader in its specialized field. The section headings are: Strength of Materials, General Principles, Transverse Strength; Cement Mortar, Cement, Sand, Mortar; Concrete; Reinforced Concrete, Experiments, Specifications, Costs. There is in addition a price list, business directory and bibliography. The compilation presents in convenient, condensed and usable form the essentials of existing knowledge and opinions in regard to concrete; and, therefore, the book should be in the working library of every engineer having to do with any phase of concrete construction. We take pleasure in recommending it.

EFFICIENCY AS A BASIS FOR OPERATION AND WAGES. By Harrington Emerson. 171 5x7½-inch pages; Works Management Library. *The Engineering Magazine*, New York City. Price, $2 net.

This book is the natural outgrowth of a series of articles originally printed in *The Engineering Magazine* from July, 1908, to March, 1909. Those articles can be truly characterized as one of the classics in the literature of industrial engineering; yet they have been so thoroughly revised and amplified that even those who read them as they appeared from month and month will find a new interest in the subject as it is now treated in book form. As expressed in the title, the keynote of the book is *efficiency* for the employee, for the employer, for the corporation, and finally for the nation. If from its pages employers and employees shall grasp the fact that in general their own methods of work are inefficient in the extreme, the book will not have been written in vain. The average man has no adequate conception of what he can really do, of what he can really accomplish, of what a shop organization can produce. If any proof is desired of this statement, turn to Mr. Emerson's book. The way in which efficiency ideals can be realized is discussed under the headings of Standards and Staff Organization, and some of the closing chapters show what may be accomplished and what has been accomplished by setting up these standards. The 12 chapter headings are: Typical Inefficiencies and Their Significance; National Efficiencies, Their Tendencies and Influence; The Strength and Weakness of Existing Systems of Organization; Line and Staff Organization in Industrial Concerns; Standards, Their Relations to Organization and to Results; The Realization of Standards In Practice; The Modern Theory of Cost Accounting; The Location and Elimination of Wastes; The Efficiency Systems in Operation; Standard Times and Bonus; What the Efficiency System May Accomplish; The Gospel of Efficiency.

INVENTIONS, PATENTS AND DESIGNS. By G. Croydon Marks. 112 4¾x7-inch pages; indexed, but no Table of Contents. D. Van Nostrand Company, New York City. Price, $1 net.

The supplementary title of the book is, "With Notes and the Full Text of the New British Patents and Designs Act, 1907." The book appears to be exceptionally well written. The various important features in connection with obtaining, maintaining, assigning, licensing, working, infringing and revoking British patents are treated of in plain nontechnical language, and in a way and in a manner which should be of direct benefit to any British patentee, whether a British subject or a foreigner. Appreciation of the American attitude in regard to patents is thus expressed in the author's preface. " . . . . there must be as keen an interest in this country as in America by those who, when engaged in manufacturing and commercial enterprises, are personally proud and publicly and privately interested in what they are producing, be it pigs, papers or phonographs, steel, ships or string." The unfairness of our own patent office procedure, by means of which an application can be amended again and again, and finally result in issuing a patent many years after the date of the original application, has been frequently pointed out and discussed. The British patent office procedure in regard to dating a patent is, therefore, interesting. "If no opposition is offered to the grant of a patent, or if the opposition fails, after a sealing fee of one pound is paid, the patent is sealed with the seal of the Patent Office, and the date of the patent is that of the original application for provisional protection, or the date of the first application with a complete specification in the event of no provisional protection being sought." Excepting the full text of the Patents and Designs Act, this book has 11 chapters with the following headings: The Meaning of "Patent;" What is Patentable; Opposition to Patent; Surrender and Revocation of Patent; Licensing an Invention; Infringements of Patents; Working in England; Threatening Legal Proceedings; Applying for Injunction; How to Work a Patent; Designs.

New Tools and Machine Shop Appliances

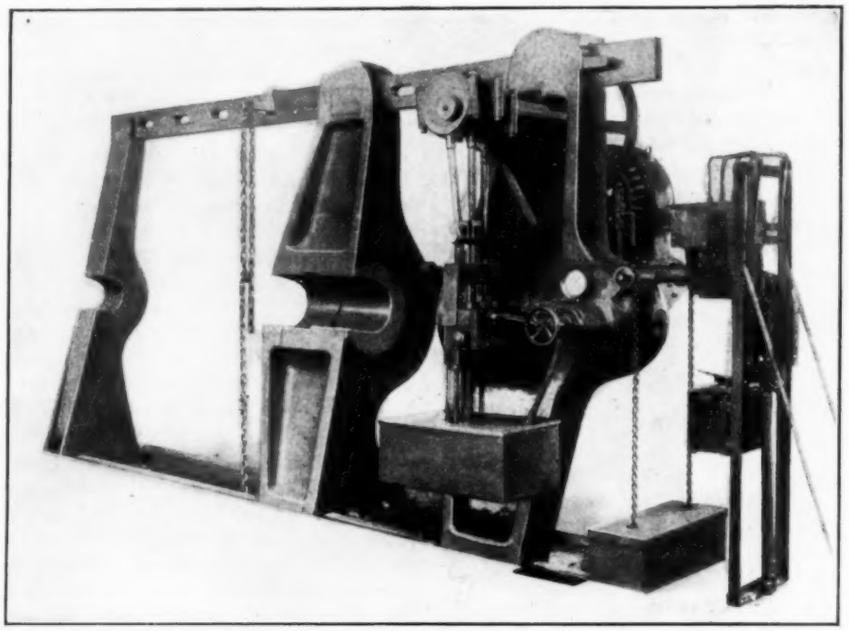
Showing New Ideas in Machine Shop Equipment That Make it Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

Electric Hydraulic Wheel Press

The illustration shows a combination of an electric and hydraulic power to a 400-ton wheel press recently installed in a large railroad repair shop. This has the advantage of being completely self-contained, the triple pump being gear driven by a 15-horsepower Hawthorn induction motor, mounted on the machine behind the plunger head. This does away with long lines of piping under heavy pressure and allows any individual wheel press to be used as desired without running a large high-pressure pump.

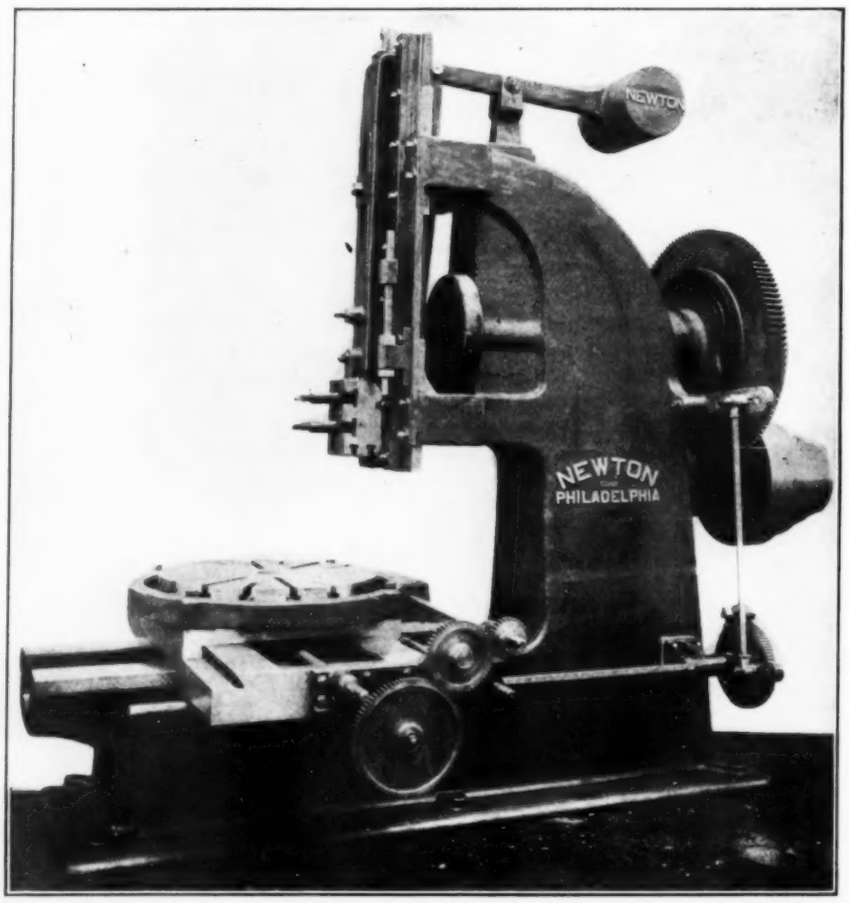
This installation was made by the Western Electric Company, New York City.



ELECTRICALLY DRIVEN HYDRAULIC WHEEL PRESS

Geared Slotting Machine

The illustrations show an entirely redesigned and remodeled slotting machine of the Newton Machine Tool Works, Philadelphia, Penn., for all sizes from 12- to 24-inch stroke, inclusive. The frame of this machine is box-type construction, being heavily ribbed and having walls of exceptional thickness for a given size machine. The cutter bar has square-lock-gibbed bearings in the guide, and the adjustment sidewise is made by a long taper shoe which gives a solid bearing the full length of the bar, whereas, in former designs this adjustment was made by means of set screws.



NEWTON SLOTTING MACHINE FROM 12- TO 24-INCH STROKE

The cutter bar is counterweighted, the arm being a forged bar, and carries a relief-tool apron having vertical and horizontal steel-faced clamping surfaces, with necessary clamps. It is arranged for vertical adjustment by means of a square shaft shown immediately above the tool apron which is arranged to revolve the elevating screw by means of bevel gears. The face of the cutter bar has finished grooves which fit tongues on the yoke washer, to relieve the elevating screw of strain when under a cut. The cutter-bar guide is arranged as shown to be adjusted vertically to support the bar when cutting in its lowest position, and is fitted to the frame of the machine by square-locked gib bearings.

The drive to the bar is through broad-faced coarse-pitch gearing, with Whitworth quick return to the stroke and a cone giving changes of speed. The con-

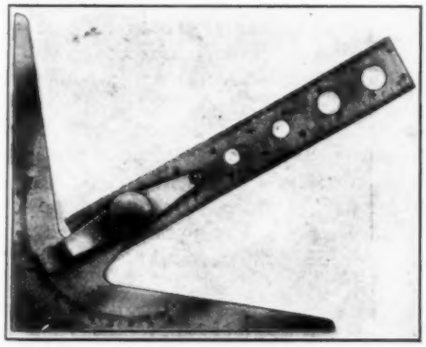
necting rod is held to the driving disk by means of a bushing having tongued face to relieve the stroke-adjusting screw from strain when taking cuts.

The circular table is especially heavy, is arranged with a central bearing for plugs to locate work, has a bearing 8 inches in diameter and 4 inches deep in the saddle, and is held securely to this bearing by means of a continuous circular clamp, having a full bearing one inch wide on the outside of the table. This circular clamp also serves as a cover for the rotating worm, the teeth for the worm wheel being cut in the periphery of the work table.

Reversing, variable, automatic-power feed and hand adjustment is provided for the circular, and cross movements. The circular table is 32 inches in diameter entirely surrounded by an oil pan. The maximum length of stroke is 15 inches; distance from face of ram to frame 32 inches, cutter-bar slide has 12 inches vertical adjustment; cross feed 36 inches; and the in and out feed 36 inches. Machine will admit work 20 inches in hight. The maximum distance from center of circular table to the face of bar is 27½ inches, permitting operations on the periphery of 55-inch diameter circles. This machine will weigh approximately 15,000 pounds, and would occupy a floor space of 3 feet 2 inches by 9 feet 2 inches. When desired, it can be arranged for motor drive, using preferably 7½ horsepower 2 to 1 or 3 to 1 variable-speed motor.

Draftsman's Square and Protractor

The accompanying illustration shows a new draftsman's square and protractor recently made by D. J. Kelsey, 515 Y. M. C. A. building, New Haven, Conn. This is made of sheet steel with the edges



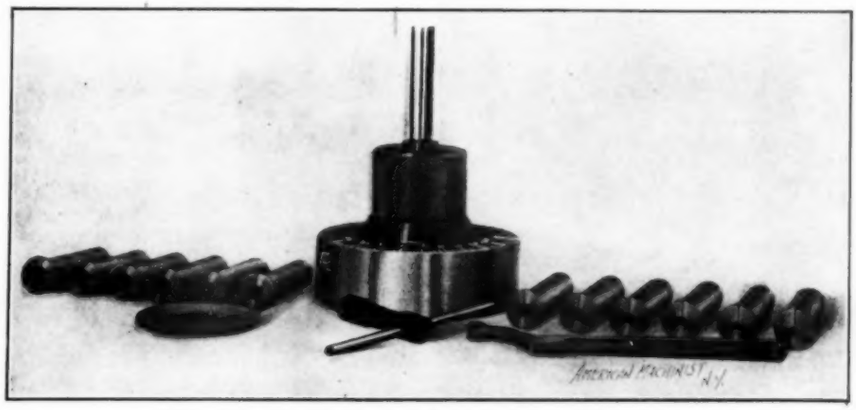
DRAFTSMAN'S SQUARE AND PROTRACTOR

turned down both to secure stiffness and prevent rubbing on the paper.

The swinging arm has both edges graduated to thirty-seconds of an inch and is bent down to make good contact with the drawings so as to allow accurate measuring in addition to being a direct ruling protractor and square. The setting, as well as the entire handling of the tool, is controlled by the knob, and there is a vernier reading to ten minutes at any point along the 90 degrees of arc graduated on the square. By setting the arm to a horizontal position and making an index mark on the drawing at some division mark of the scale, the square may be readily moved along for very accurate ruling without pointing off. This can, of course, be done either horizontally or vertically. The square is 8 inches long on each side and has a 9-inch arm although a 15-inch arm can be supplied when desired.

A Draw-in Chuck for Concentric and Eccentric Work

The halftone shows a new draw-in chuck, for the manufacture of duplicate parts, which has recently been put on the market by J. A. Jarvis, 112 Broad street, Lynn, Mass. The outer body of the chuck is bored eccentric to receive the inner



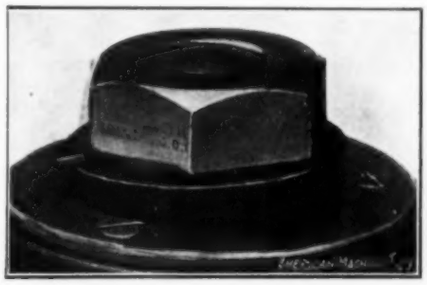
A DRAW-IN CHUCK FOR CONCENTRIC AND ECCENTRIC WORK

body to which the draw-in collets are fitted. The face of the outer body is graduated in the arc of a circle each graduation signifying 0.001 inch eccentricity of the inner body and draw-in collet, a pointer on the inner body permitting easy reading. The total amount of eccentricity is ¼ inch. With this method of mounting the collets in an adjustable eccentric sleeve with a pointer to indicate the amount of eccentricity and a locking arrangement to bind the inner and outer bodies securely together, it is possible with the aid of a hardened and ground test bar to adjust them so that they run absolutely true.

The chuck can be mounted in the engine lathe or grinder. In the milling machine it is very useful in connection with a boring bar for obtaining holes of definite size. The rough hole is first made with a twist drill and then the single-toothed boring tool is inserted and by the use of the eccentric adjustment the boring bar can be thrown off center the desired amount. Working parts are made of steel hardened and ground.

A French Nut Locking Device

This is a very interesting nut-locking device made on the principle of the coil clutch, and is becoming very well known in France, England and other European countries. It requires very little explanation, the nuts being turned round for a portion of its length to afford a friction surface for the coiled spring which surrounds it when in place. This coil is made from a flat strip of steel, as can readily be seen and has the lower ends



A FRENCH NUT-LOCKING DEVICE

bent down to hook into a hole in the washer beneath. It is bored to a good fit and coiled in such a way that screwing the nut down tends to open the coil, while unscrewing it causes the coil to grip tightly around the round portion of the nut and prevents its backing off. The projecting end shown affords an easy method of releasing the nut, as by pressing or this the coil is opened slightly and the nut can be readily unscrewed.

This is made in Paris, France, by I. H. de Bussierre, 61 rue de Chaillot, from whom the American patent can be obtained.

The Wright Quick Acting Wrench

The quick-acting wrench illustrated at page 815, Volume 30, Part 2, is now being made in a variety of sizes, as well with a drop-forged steel handle which forms the head.

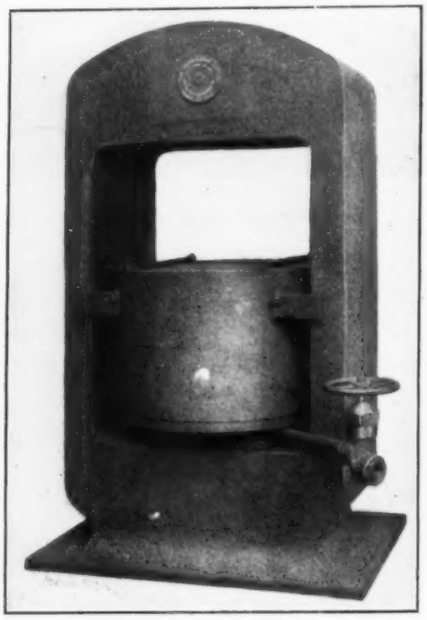
It is made without a screw and is adjusted to fit the nut by means of slight

pressure upon the jaw with the thumb of the hand holding the wrench. Only one hand is thus required to adjust and operate the wrench.

The Wright Wrench Company, Canton, Ohio, manufacturers of these wrenches, are also making a special automobile wrench constructed on the same principle.

A Heavy Hydraulic Press

The press shown in the halftone consists of but three main parts; the frame, the cylinder, and the ram. At a working pressure of 7500 pounds per square inch it will exert a pressure of 1600 tons. The cylinder is 24 inches in diameter. The



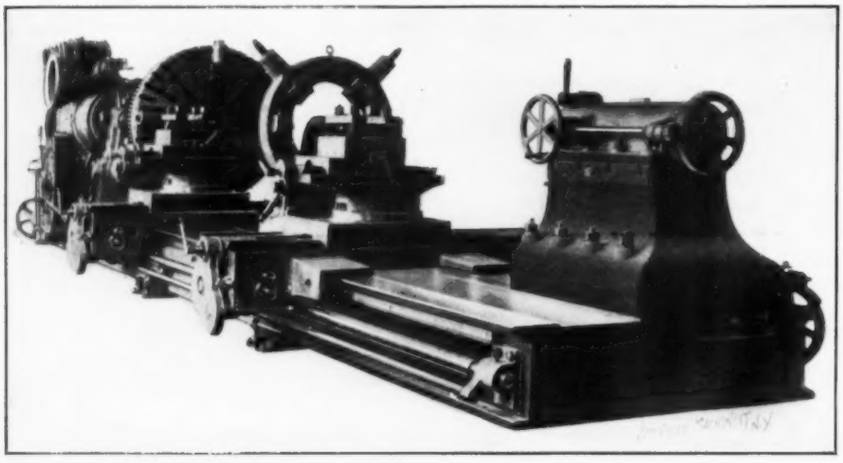
A HEAVY HYDRAULIC PRESS

opening on top of the cylinder is 22 inches high by 40 inches wide. The total hight of the machine is 8 feet, and its weight is 23,000 pounds. Where rods are used, instead of the main frame, to take the pressure, the weight of a press for the same capacity is about 40,000 pounds.

This press was built by the Charles Burroughs Company, Newark, N. J., for dehydrating nitro cellulose mixed with camphor preparatory to making a material similar to celluloid.

A Heavy French Lathe

This lathe has a capacity of about 7 feet in diameter and will handle work 22 feet long between centers. It is motor driven, having a five-step cone pulley arranged for the V-shaped belt, which seems to be a common practice in France.

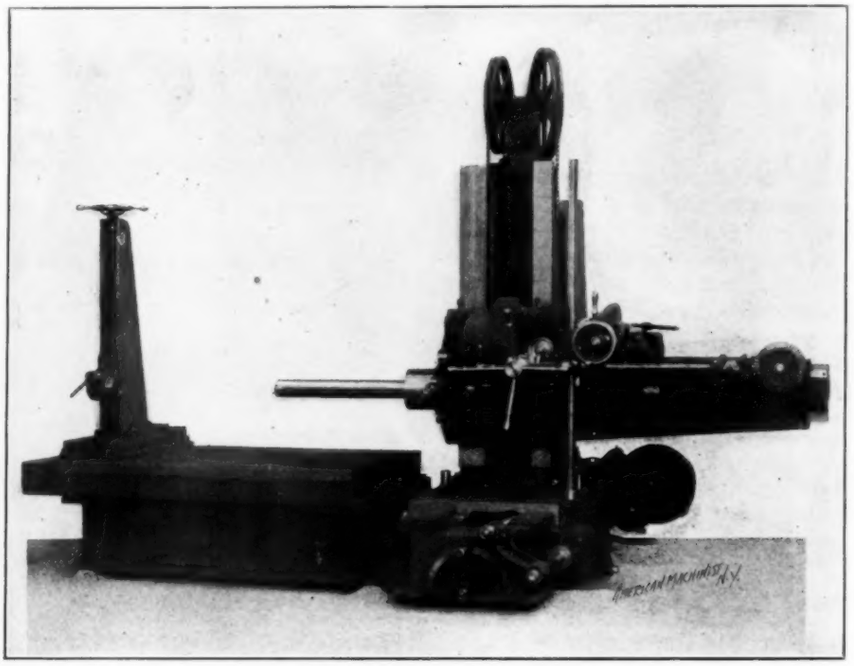


A HEAVY FRENCH LATHE

The most interesting feature of the design is the extremely wide bed, which brings a very substantial flat way out under the front of the carriage and gives a direct support to the tool post in turning the largest work. The tailstock is clamped by the four bolts. There is a central support for the carriage bridge. Two carriages are supplied and independent chuck jaws are shown in place on the faceplate. This is built by the Société Alsacienne de Constructions Mechaniques, of Graferstaten.

Horizontal Boring, Drilling and Milling Machine

The accompanying illustration represents the latest design of horizontal boring, drilling and milling machine put out by the Fosdick Machine Tool Company, Cincinnati, O., which is designed to perform



HORIZONTAL BORING, DRILLING AND MILLING MACHINE

the operations of drilling, milling, boring, tapping, facing, etc., on both light and heavy work.

The column carrying the spindle head has horizontal movement on the bed by hand or power in both directions; also a quick forward and return motion by power, operated by a lever conveniently located on the front of bed. The head, which is counterbalanced and provided with a safety chain, has vertical movement on the column by hand or power in both directions. For quick adjustment the pilot wheel on the front of the spindle head is used.

The spindle sleeve runs in adjustable bronze bearings and has a thread cut on its front end to hold chucks, large milling cutters and facing heads for heavy work. The spindle bar which passes through the sleeve is driven by two keys; is fitted with a No. 4 or 6 Morse taper, and provided with a cotter key to be used when driving large boring bars. It has a power and hand feed in both directions. The spindle driving gears are located on the spindle sleeve close to the work. This

construction aims to reduce torsional stresses in the spindle to a minimum, and to eliminate chattering when using large milling cutters. The back gears are of the tumbler type, and can be engaged while the machine is in motion by means of a lever conveniently located on the head.

The outer support for boring bars has horizontal and vertical movement by hand and is provided with scales, same as are fitted to the main column and bed. The table in which the T-slots are planed is stationary and securely bolted to the base and bed, insuring perfect alinement with the spindle at all times. There are eight changes of feed, ranging from 7/1000 inch to ¼ inch per revolution of spindle.

Sixteen changes of spindle speeds, ranging from 4 to 260 revolutions per minute are secured either through the cone pulley or speed box, by using a double-speed countershaft.

For a constant-speed motor drive a 7½-horsepower motor, 825 revolutions per minute, is mounted on the rear of the machine and connects through gearing to the speed box. For a variable-speed motor drive a 7½-horsepower motor, 400 to 1600 revolutions per minute, is used and is mounted on the rear of the machine and connects through gearing direct to the driving shaft. The controller is mounted within easy reach of the operator.

Bronze-bushed bearings and steel gears are used throughout the machine, which is made in two sizes, having respectively a 3½- and 4-inch spindle bar; 28- and 30-inch traverse of spindle; 42x72-inch and 42x120-inch table.

Forthcoming Meetings

National Gas and Gasolene Engine Trades Association, Chicago, November 30, December 1 and 2. La Salle hotel. Albert Stritmatter, secretary, Cincinnati, O.

National Society for the Promotion of Industrial Education, annual convention, December 1, 2 and 3, Milwaukee, Wis. J. C. Mcnaghan, secretary, 20 West Forty-fourth street, New York City.

American Society of Mechanical Engineers, annual meeting, New York City, December 7-10. Calvin W. Rice, secretary, United Engineering building, New York City.

American Society of Agricultural Engineers, third annual meeting, December 28-29, 1909, Ames, Ohio. F. W. Chase, secretary, University of Nebraska, Lincoln, Neb.

Business Items

The name of the Robertson Drill and Tool Company, Buffalo, N. Y., has been changed to Frontier Iron Works. W. F. Semon, president and treasurer; W. Robertson, vice-president; J. W. Murphy, secretary.

Taylor Machinery Company, at present doing business at 8 Oliver street, Boston, Mass., has just placed orders for a stock of metal-working machinery to be carried in their show room at 42 Oliver street, which will be their new location after January first.

The Bath Grinder Company, Fitchburg, Mass., has increased its capital stock from $20,000 to $100,000, with the same management as before: John Bath, president; A. L. Goodnow, vice-president; Robt. D. Gould, secretary. The plant will be doubled and new equipment bought.

At the annual meeting of the Standard Roller Bearing Company, of Philadelphia, held recently, the directors elected the following officers for the ensuing year: President, Lenox Smith; vice-president, W. B. Osgood Field; vice-president and general manager, R. S. Woodward, Jr.; secretary and treasurer, W. M. Baldwin.

Business Opportunities

Armour & Co. will erect a plant at Chrome, N. J.

C. D. Marr, Fremont, Neb., will erect a foundry.

A. S. Hall, Omaha, Neb., will erect a $40,000 garage.

Merck & Co., Rahway, N. J., will enlarge its power plant.

J. C. Carter, Bradford, Fla., will rebuild his burned sawmill.

E. W. Phillipe, Ottumwa, Iowa, is erecting a sheet-metal factory.

The Chrome Steel Works, Chrome, N. J., is building an addition.

The Carter White Lead Company, Omaha, Neb., will erect a factory.

The tannery of Blank Brothers, Winchester, Mass., was destroyed by fire.

Jos. Wolfinger, of Dundas, Wis., will erect a box factory at Antigo, Wis.

H. C. Aberle & Co., Philadelphia, Penn., is enlarging its power house.

The Minneapolis (Minn.) Milk Company is to install a new power plant.

The Bryant Box Company, Westfield, Mass., will erect a four-story factory.

The Dick Safe Cabinet Company is erecting a new plant in Norwood, Ohio.

The Columbus (Neb.) Brick Company will spend $50,000 for improvements.

The Warden Carriage Company, Cleveland, Ohio, will erect a new building.

The Metal Product Company, Providence, R. I., is building a new factory.

H. E. Netcott, of Waverly, Iowa, will erect a canning factory to cost $50,000.

The Canada Fiber Company, Moose Jaw, Sask., Canada, will erect a factory.

D. T. and M. S. Gilman, 609 Pierce street, Sioux City, Iowa, will erect a garage.

The Royal Manufacturing Company, Rahway, N. J., will enlarge its power plant.

Explosion and fire at Pabst Brewery, Milwaukee, Wis., caused a loss of $250,000.

The shop of the Empire Machine Works, Penn Yan, N. Y., was destroyed by fire.

A. J. Pace & Son, Kimmons, Tenn., will establish a sawmill near Houston, Texas.

The Millers Falls Company, Millers Falls, Mass., will build an addition to its plant.

R. D. Tilinghast, McDonald, Penn., has completed plans for a new machine shop.

The Worcester (Mass.) Bleach and Dye Works Company is erecting a new plant.

The United Wire and Supply Company, Providence, R. I., is building a new factory.

The Kiel (Wis.) Furniture Company is having plans prepared for a new table factory.

The Milwaukee (Wis.) Reliance Boiler Company will erect a new two-story machine shop.

The Joliet (Ill.) Bridge and Iron Company is to establish a branch plant in Memphis, Tenn.

The Waldron Runabout Manufacturing Company, Kankakee, Ill., is building an addition.

The New England Box Company, West Swanzey, N. H., is building a new power plant.

Guthrie (Okla.) Bedding Company will establish a plant for manufacturing mattresses.

H. D. Dougherty & Co., Philadelphia, Penn., mattress manufacturers, are building a new factory.

The Miller Wire Reel Company's factory at Park Falls, Wis., was destroyed by fire. Loss, $35,000.

The Indiana Brass and Iron Bed Company, Mooresville, Ind., is erecting a $10,000 addition.

W. L. Davis, Eau Claire, Wis., will build a paper mill at Jim Falls, Wis., to cost $150,000.

The New Method Laundry, 73 North Fourth street, Columbus, Ohio, will install an electric motor.

The Glueck Brewing Company, Minneapolis, Minn., will erect an addition to its bottling department.

W. M. Lawrence, 621 Fourth avenue, South Minneapolis, Minn., will build a landry to cost $8000.

The National Enameling and Stamping Company, Granite City, Ill., will erect a power plant.

The St. Louis Southwestern Railroad has broken ground for new machine shops at Tyler, Texas.

The Bode Wagon Company, Cincinnati, Ohio, is said to be planning the erection of a new plant.

The Pacific Car and Foundry Company has selected site in Portland, Ore., for a new $80,000 plant.

The shingle mill of M. R. Smith, at Rayville, Wash., was destroyed by fire. Loss, about $10,000.

It is reported that the Denver & Rio Grande Railroad will build a big roundhouse at Grand Junction, Colo.

The Brennan Motor and Manufacturing Company, Syracuse, N. Y., will erect a two-story addition.

The Means & Fulton Iron Works Company, North Birmingham, Ala., is planning to enlarge its plant.

The Nadean-Kaolin Putty Company, Norfolk, Va., will erect a plant for the manufacture of paints.

The W. Eddy Plow Company, Greenwich, N. Y., has purchased more land for enlargement of its plant.

The Capitol Packing and Provision Company, Columbus, Ohio, is having plans prepared for a plant.

The sawmill of the John R. Davis Lumber Company, Phillips, Wis., was destroyed by fire. Loss, $150,000.

The New Britain (Conn.) Machine Company has secured permit to erect a five-story addition to its plant.

The Scott Chair Manufacturing Company, Newark, Ohio, is in the market for a 50-horsepower gas engine.

The Kirkhan Motor Manufacturing Company, Bath, N. Y., is to install a number of additional machines.

The Helling Silk Dyeing Company, Philadelphia, Penn., has let contract for the construction of new factory.

The Sterling Engine Company, Buffalo, N. Y., has awarded contract for the construction of its new factory.

The American Hide and Leather Company is planning the erection of a $148,000 beaming plant in Lowell, Mass.

The Baltimore (Md.) Enamel and Novelty Company will erect several additions, including a new blacksmith shop.

The E. L. Shuford Manufacturing Company, Hickory, N. C., will erect a $500,000 cotton mill in Lacoton, Okla.

C. G. Conn & Co., Elkhart, Ind., horn manufacturers, is said to be contemplating the construction of a new factory.

The American Agricultural Chemical Works, Carteret, N. J., is building an addition and also increasing its power plant.

Machine shop, pipe shed and store room will be erected for Roe & Conover, Newark, N. J., hardware manufacturers.

The Owens Glass Company, of Toledo, Ohio, will erect a bottle plant in Fairmont, W. Va., to cost nearly $2,000,000.

Fire destroyed the crate and box plant of the Miller Manufacturing Company, Park Falls, Wis. Loss, about $25,000.

The D. J. Murray Manufacturing Company, Wausau, Wis., will build an addition to its pattern and molding departments.

The Harvard Brewing Company, Lowell, Mass., has taken out permit for the erection of a boiler house to cost about $14,000.

The Herring-Curtiss Company, Hammondsport, N. Y., is building a new machine shop in connection with its aëroplane shop.

The Indianapolis (Ind.) Brass Company has bought site for a new plant for the manufacture of electric-railway material.

George W. Jackson, Inc., Chicago, Ill., has bought site on which a structural iron-works plant is to be erected to cost about $2,000,000.

The Twin City Rapid Transit Company, Minneapolis, Minn., will erect a $20,000 repair shop at Snelling and University avenues.

The McCullough-Dalzell Crucible Company, Pittsburg, Penn., has awarded contract for construction of additions to the plant to cost $13,000.

The Haney-White Company, Philadelphia, Penn., is erecting a new factory for the manufacture of mantels, grates, hard-wood flooring, etc.

The Remington-Sherman Company, Philadelphia, Penn., manufacturing safes and vaults, will erect additions to its machine and erecting shops.

The Pacific Brass and Hardware Manufacturing Company, Los Angeles, Cal., will establish a plant for the manufacture of builders' hardware.

The Southern Pacific Railroad has acquired site in Oakland, Cal., on which one of the most extensive machine shops of the system will be erected.

Dixie Motor Car Company, Oklahoma City, Okla., capitalized at $100,000, will erect a plant for the manufacture of automobiles. R. C. Bennett is president.

The Ancos Company, Binghamton, N. Y., manufacturing cameras and camera supplies, is to enlarge its present plant and move its New Jersey plant to Binghamton.

The Kearney & Trecker Company, West Allis, Wis., milling-machine manufacturers, will erect a $160,000 addition to its plant to consist of a blacksmith and machine shop.

The Superior Furniture Company, Rockford, Ill., a new concern, is erecting a plant which, it is said, will be the largest of the kind in the city. A. W. Mann is interested.

The Buckeye Rolling Mill Company, Newark, Ohio, has taken over the plant of the Ohio Rail Company and is enlarging and improving same for the purpose of manufacturing light rails.

The George N. Pierce Company, Buffalo, N. Y., manufacturing automobiles and bicycles, will erect two new four-story factory buildings. It is said about $200,000 will be expended on equipment.

Pawling & Harnischfeger, Milwaukee, Wis., are building an addition to their plant. Considerable new equipment is to be installed for the purpose of building their new combination drill and boring machine.

The Peterman Manufacturing Company, Tacoma, Wash., has taken out permits for reconstruction of its plant recently burned. This will consist of a sash and door factory, sawmill, dry kiln and boiler room.

The Hawxhurst Wind Turbine Power Company, Los Angeles, Cal., capitalized at $200,000, is looking for site on which to erect a plant for the manufacture of turbines for pumping water. H. L. Hawxhurst is president.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: Nov. 16—Twist drills, taps, washers and nuts (schedule 1897; Nov. 23—Generating sets, turbo and motor (schedule 1903); Nov. 30—Pipe fittings, rubber hose (schedule 1891), steam gages, flexible metallic steam hose (schedule 1892), twist drills, rivets, brass machine and wood screws, hand tools (schedule 1890); Dec. 7—21-inch back-geared drill press, 8-inch precision lathe (schedule 1900).

New Incorporations

May Hosiery Mills, South Nashville, Tenn. Capital, $60,000. Incorporators, Jacob May, Leo Martin, M. Martin, etc.

Dunham-Yager Motor Car Company, Louisville, Ky. Capital, $12,000. Incorporators, George Dunham, R. T. Yager, A. M. Dick.

Bard Automobile Company, Camden, N. J. Manufacture automobiles. Capital, $250,000. Incorporators, F. N. Hansell, G. H. B. Martin, J. A. MacPeak.

Wendel Screen Manufacturing Company, Walpole, Mass. Manufacture screens. Capital, $40,000. Incorporators, O. Wendel, H. H. Miller, etc.

Wheeler Rotary Engine and Power Company, Meriden, Conn. Capital, $200,000. Incorporators, W. W. Wheeler, W. H. Way, W. H. Ardes, etc.

William H. King Company, Newark, N. J. Manufacture boilers, hardware, etc. Capital, $50,000. Incorporators, W. H. King, W. T. Learey, A. A. King.

George J. Arnold Company, Syracuse, N. Y. Manufacture vehicles, carriages, machines, etc. Capital, $25,000. Incorporators, G. J. Arnold, C. J. Roehm.

Monatiquot Rubber Works Company, Braintree, Mass. Manufacture rubber. Capital, $50,000. R. J. Cram, Boston, president. A. N. Hunt, Braintree, treasurer.

Craven Foundry and Machine Company, New Bern, N. C. Foundry and machine shop. Capital, $100,000. Incorporators, H. P. Willis, W. T. Bruison, T. W. Shriner, etc.

Beaver-Brook Woolen Company, West Eaton, N. Y. Manufacture worsted and cotton goods. Capital, $25,000. Incorporators, J. W. Stolts, E. J. Stolts, F. E. Carpenter, New York.

Springfield Motor Car Company, Springfield, Ill. Manufacture automobile parts and accessories. Capital, $100,000. Incorporators, H. C. Medcraft, A. H. Rankin, etc.

The Universal Tire Protector Company, Angola, Ind. Manufacture tire protectors for automobiles. Capital, $20,000. Incorporators, S. C. Wolfe, E. S. Croxton, J. R. Nyce, etc.

Electric Supply and Fixture Company, Fort Wayne, Ind. Manufacture gas and electric fixtures. Capital, $25,000. Incorporators, S. M. Foster, F. N. McCulloch, H. L. Saylor.

Weintraub Brass Manufacturing Company, New York. Manufacture brass goods, novelties and antiques. Capital, $40,000. Incorporators, C. Springer, F. Weintraub, J. Weintraub.

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned if not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper catalog free. E. G. Smith Columbia, Pa.

We solicit your representation. Maxant & Company, 222 So. Canal St., Chicago, Ill.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Light manufacturing; experimental and model work; metal patterns and tools. Bahnsen & Barr, Auburn, N. Y.

Gears; we are in position to take contracts for cutting gears on Fellows gear shaper. The Sinclair-Scott Co., Baltimore, Md.

Machines designed; automatic special. Practical working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emery & Co., Newark, N. J.

Have you small, complicated experimental work or tool designing others can't do? Send to Benj. O. Butler, Taunton, Mass.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

Metal specialties manufactured, models, dies and special machinery; inventions perfected. Villinger Mfg. Co., Williamsport, Pa.

Wanted—Purchaser for No. 2 Farwell milling machine, Grant hobbing machine and Gisholt tool grinder; all practically new and in A-1 condition. Box 755, AMER. MACHINIST.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

ILLINOIS

Superintendent, experienced in engine work and electrical machinery; capable executive and organizer, desires change. Box 871, AM. M.

MASSACHUSETTS

Foreman toolmaker, at present employed, desires change. Box 872, AMER. MACHINIST.

Position as superintendent or general foreman of machine works or electrical manufacturing, by an experienced man. Box 846, AMERICAN MACHINIST.

Wanted—Position as foreman of screw machine department; expert on estimating, speeds and feeds and the best method of production. Box 847, AMERICAN MACHINIST.

Experienced executive, first-class draftsman and designer, and all-round toolmaker, desires position as superintendent or chief draftsman. Box 842, AMERICAN MACHINIST.

Practical young man, 28 years old, experience in shop, drafting, office and costman, seeks opportunity to get training as traveling salesman in preparation for ambitions; money no object; good references, ability and character; any fair offer from reliable concern will be appreciated and duly repaid. Box 874, AMERICAN MACHINIST.

MICHIGAN

Wanted—Semi-executive connection with firm building general, medium and heavy machinery; successful designer; 32 years of age; good reasons for desiring change; clean record; best reference. Box 863, AMER. MACH.

Adding machine inventor and designer, who has "made good" with his present employers, but who desires a broader field and greater

responsibility, invites correspondence from progressive adding machine concerns. Box 864, AMERICAN MACHINIST.

NEW JERSEY

Mechanical draftsman wishes position. Address Box 832, AMERICAN MACHINIST.

Mechanical engineer, experienced in power plant design and installation, manufacturer of condensers, pumps, piping. Box 860, AM. M.

College graduate, 31, with practical experience as machinist and foreman, tool designer, familiar with modern shop methods, wants to change; good references. Box 862, AM. MA.

Wanted—By experienced mechanic, wishing change, position as tool room or general shop foreman; up-to-date in modern shop methods; at present holding similar position; good references; location, not material. Box 865, AMERICAN MACHINIST.

Salesman—Machine tool salesman as sales manager, having 15 years' experience, both in the manufacture and selling of machine tools; competent judge of condition and value of second-hand, and familiar with all makes in the United States; can give best of reference. Box 790, AMERICAN MACHINIST.

NEW YORK

Draftsman, experienced designer on printing machinery, technical education, shop experience, wishes to change. Box 875, AM. M.

Mechanical engineer, experienced in management of large machine works, with mechanical and executive ability of high order, desires position as superintendent. Address "Ability," AMERICAN MACHINIST.

Production engineer of wide experience in developing earning power, factory analysis, rate setting, organization of departments, cost systems and discipline, wishes permanent position on contract, salary or percentage; location immaterial. Box 868, AMER. MACH.

As expert foreman diemaker or superintendent, thoroughly uptodate on blanking, piercing, drawing, forming and bending dies; compound and sub-press dies, etc., for rapid and accurate production; good executive; ability excellent; references. "M," AMER. MACH.

PENNSYLVANIA

Designer, age 32, graduate mechanical engineer, 12 years' experience fine apparatus, typewriters, adding machines, tools, automatic machinery, especially expert on experimental development and design, desires position in charge of such, or as chief draftsman, leading designer, etc. Box 873, AM. MACH.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Wanted—Draftsman, experienced on steam pumps for revision and redesign of standard duplex pumps; give full particulars, practical experience, salary expected and when available first letter. Box 858, AMER. MACHINIST.

CONNECTICUT

Wanted—Experienced mechanical draftsmen for detail work, in a concern manufacturing general rolling mill and hydraulic machinery; state age, experience and salary expected. Box 796, AMERICAN MACHINIST.

Salesman wanted, having had experience in selling to the mill supply and hardware trade, also manufacturers to represent us in our chain block department; give experience and references. Box 866, AMERICAN MACHINIST.

Wanted—One hundred first-class machinists; give age, experience, complete references, salary expected; nine-hour city; ideal labor conditions; "trouble" unheard of; living costs low. Apply Bridgeport Manufacturers' Association, Bridgeport, Conn.

Wanted—In a large New England manufacturing plant, an experienced millwright and carpenter, familiar with heavy work, to act as foreman of carpenter's shop (about twelve carpenters) and to take charge of all repairs and the erection of new buildings and machinery. Address "F," AMER. MACH.

ILLINOIS

Wanted—Foreman for machine department by concern manufacturing small gasolene engines in large quantities; factory is splendidly equipped with the most modern machinery; must be a first-class mechanic and good executive; in your reply state experience, with whom, whether married or single, age and salary expected; it is not necessary that one is experienced on gas engine work, but it is necessary that one is experienced on rapid manufacturing methods. Box 856, AM. MA.

INDIANA

Wanted—A No. 1 electrical instrument maker on fine experimental work; must be young man, good on small tool work; state age, experience and lowest wages; with growing concern. Box 859, AMER. MACHINIST.

MASSACHUSETTS

Wanted—First-class draftsmen. Apply Supervisor of Drafting Rooms, General Electric Company, Pittsfield, Mass.

Wanted—Capable executive to take charge of rate setters in engine works; must be experienced in determining piece rates, both directly and indirectly, from analytical time study observations; state age, experience and pay expected; correspondence confidential. Address "R. S. D.," P. O. Box 167, Boston, Mass.

Wanted—At Leominster, Mass., mechanical draftsman with general experience; state age, nationality, training, previous employment and salary expected. Box 185, Leominster, Mass.

Rate Setters Wanted—Must have had experience with time study method, using stop watches; opportunities for advancement in Massachusetts plant building engines, marine specialties, etc.; state age, experience and salary expected. "R. S.," 24, Box 167, Boston, Mass.

MICHIGAN

Blacksmith foremen, accustomed to work on heavy forgings; good wages; steady employment. Apply Northern Engineering Works, Detroit, Michigan.

Wanted at once, toolmakers, die sinkers, trimming diemakers, machinists, automatic screw machine hands; state age, experience, customary wages and references. Buick Motor Company, Flint, Mich.

MISSOURI

Wanted — High-grade experienced emery wheel salesman to sell carborundum. W. R. Colcord Machinery Co., St. Louis, Mo.

NEW JERSEY

Tool draftsman wanted; must be man well up on tools for small duplicate work; state experience and wages expected; also age and references. Box 808, AMERICAN MACHINIST.

Foreman, for small manufacturing shop, running between 15 and 20 men, building a line of special machinery; the position is not an easy one as the work is varied and considerable of it built to order; shop equipment modern. In answering, give full particulars as to age, experience and reference. Box 850, AMERICAN MACHINIST.

NEW YORK

First-class Gisholt turret lathe operators; men who can design and make tools, also run the lathes. Box 821, AMERICAN MACHINIST.

Wanted—Draftsman familiar with design and construction of steam hammers. Write giving references and stating salary expected. Box 784, AMERICAN MACHINIST.

Machine molders wanted for brass foundry work; write giving experience and wages expected; nine hours, open shop, in small city; living expenses and rent low. Box 857, AM. M.

Wanted—A thoroughly competent web printing press draftsman; man of experience and ability can have permanent position at high salary; communications confidential. "W. W. C.," AMERICAN MACHINIST.

Wanted—Expert screw machine operator as assistant foreman; must be familiar with Brown & Sharpe, Gridley automatic and Garvin hand machines; steady job to man capable of filling the above; give full particulars regarding age, experience and wages. Box 867, AMERICAN MACHINIST.

We are looking for a young man thoroughly familiar with factory office routine; will use him partly on production and partly on repair orders in the automobile line; we also have vacancies for several draftsmen with automobile experience, factory office experience in addition would be desirable; state age, nationality, education, experience in detail and salary expected. Box 861, AM. MA.

OHIO

One gas engine machine shop foreman, who is acquainted with piece work. Box 855, AMERICAN MACHINIST.

Wanted—Experienced draftsman for designing and detailing on sheet-metal working machinery; steady position offered. Box 870, AMERICAN MACHINIST.

Wanted—First-class large lathe and planer operators; good wages and steady work for the right parties; location, medium size town in central part of Ohio. Box 834, AM. MACH.

Machinists—We are increasing our output and invite application from machinists with experience on planers, turret lathes, boring mills, milling machines, screw machines, etc.; state fully, experience and wages. Foos Gas Engine Co., Springfield, Ohio.

Wanted — First-class machinists, lathe, planer, brass molders, drill press, screw machine, boring and milling machine operators, die sinkers and patternmakers who are seeking positions or desirous of improving on those which they have, to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address Commissioner's Office, 605 New England Building, Cleveland, O.

PENNSYLVANIA

Wanted—Good mechanical draftsman; one familiar with valves preferred; state age, salary and experience. Box 876, AMER. MACH.

Wanted—Assistant foreman, machining department; factory making mechanics tools; promotion; state wages, age, experience. "X. Y. Z., AMERICAN MACHINIST.

Man, experienced in punch and die work. Address, giving experience, references, and salary required, to Machen & Mayer Electrical Mfg. Co., Philadelphia, Penn.

Several all-round machinists and toolmakers wanted on light accurate work; good location, best machinery; only married men, sober and industrious and close mechanics need apply. Box 851, AMERICAN MACHINIST.

First-class general machinist wanted, principally to operate milling machine on general tool room work; must be an accurate workman and show results; small warm shop nicely located. Box 852, AMER. MACHINIST.

Wanted—A good live agent in every shop or factory in the U. S. to sell one of the best known preparations for removing grease and grime from the hands without injury to the skin. Absolutely guaranteed. An agent can make from $5.00 to $25.00 over and above his regular salary. This is no fake. Write for free sample and agents' terms. The Klenzola Co., Erie, Pa.

WISCONSIN

Wanted at once, National-Acme and Cleveland automatic screw machine operators. Box 869, AMERICAN MACHINIST.

Draftsman Wanted—About thirty years old, having had experience on paper machines; none others need apply; send references, very full particulars as to experience and lowest salary required. Box 853, AMER. MACHINIST.

For Sale

For Sale—Machine shop and foundry well equipped, successfully running under lease in best town in eastern Oregon; a rare bargain; $6000 cash, balance time. Box 836, AM. M.

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Analyzing Machine Operations with a Meter

Machine-shop Output Can Be Increased by a Study of Machining Operations from Power Shown by Graphic Recording Meter

BY A. G. POPCKE

All those engaged in regular manufacturing operations know the utmost importance of economizing time in performing each machine operation. The cost of any operation is made up of the direct labor charge and the indirect, or overhead, charge. Analysis shows that the latter is from one to three, or more, times the direct labor charge in large shops. The more important items constituting the indirect labor charge are:

Interest and depreciation on the cost of the equipment.

Interest and depreciation on the cost of building, grounds and accessories.

Taxes and insurance on equipment, buildings and grounds.

Repairs to equipment, buildings and accessories.

General supervision.

Power, heat, light and water.

The indirect charges are more or less fixed charges and go on whether the equipment is operating or out of service. Any method which may be devised toward eliminating delays, with the result of turning out an increased product from a given tool will not only reduce the cost thereof, but will often reduce the necessity for expansion of the plant to take care of an increasing amount of work.

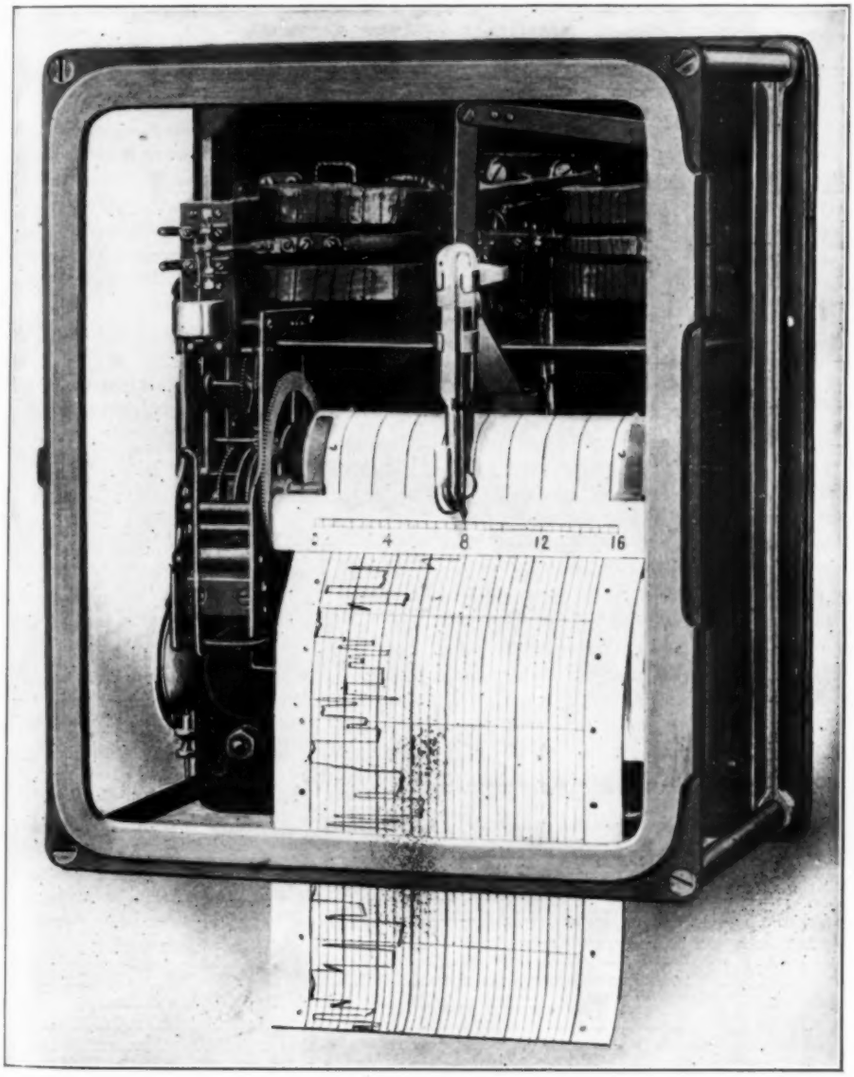


FIG. 1. WESTINGHOUSE GRAPHIC RECORDING WATTMETER

Investigations tending to eliminate avoidable delays have usually been expensive and more or less complicated, involving as they do, a vast amount of clerical effort and supervision to obtain the desired results. For this reason many investigators have endeavored to reach a simple solution. It is the purpose of this article to bring to the readers' attention the means of accomplishing substantially the desired result in a very simple manner.

Obviously, if a manager or superintendent has before him a graphic log of the daily operations of each tool, he will be able to see at a glance all opportunities for removing causes of delay, to know whether or not the facilities are such that the tool is worked to its maximum capacity, and finally, the most important feature, whether work is being done at the maximum possible rate for a given job or for a given tool.

From investigations and tests made by the Westinghouse Electric and Manufacturing Company, it is found that with some tools, the principal causes of delay in production may be enumerated as follows:

1. Lack of facilities for handling and loading the tool.

2. Delays occasioned by the workman being required either to grind his own tools or return them to the tool room for grinding.

3. Incomplete equipment of tools or tools improperly ground or shaped for the work to be performed.

4. Improper driving equipment.

Of the foregoing causes No. 1 can be eliminated in some instances by providing hoists at the tools for handling the material in and out.

The remedy for cause No. 2 is obvious; more than one set of tools can be provided, one set being sharpened while the other is in use. The operator's time should be devoted to his machine, the grinding being done by others.

Causes Nos. 3 and 4 can be eliminated only by a detailed study of the method of operating the tool and the advantages accruing from the use of the proper tools and driving equipment.

Use of a Graphic Recording Meter

With motor-driven tools such a study can be made by installing a Westinghouse graphic recording ammeter or wattmeter, Fig. 1, the selection being determined by the character of the electric supply circuit. This instrument can be installed in the foreman's office or some other small control station located near the tools. A pair of small wires is run permanently

from the meter to each tool from which it is desired to obtain records.

Experience shows that one meter can be used for either of several tools, depending upon the uniformity of the work being done. Where there is much duplication of the same operation, only occasional records are necessary and one meter can be used with a number of tools. If the work varies materially, the number of tools which the meter can serve is more limited.

The instrument is somewhat like an indicating meter, but instead of being provided with a needle passing over a graduated scale, a pen moves horizontally making a mark on a paper properly graduated. The paper is moved vertically by clockwork so that a permanent record of the magnitude and the time of all changes in power consumption is obtained.

A Typical Meter Curve

Fig. 2 shows a typical curve, lettered for reference purposes, taken while roughing out a steel shaft on an engine lathe. The record is read from right to left as noted from the hour marks at the bottom. The hight of the mark above the bottom at any time indicates the power consumed at that time.

One shaft was completed in the time between the periods marked "Change" just before 2 o'clock and just before 3 o'clock. The cross hatching indicates the metal removed from the stock to obtain the completed size of the shaft. The letters on the curve and the sketch correspond. Just before 2 o'clock the workman completed a shaft and shut down the motor, as indicated by the zero reading of current in the interval marked "Change." During this interval of eight minutes he removed the completed shaft and placed new stock in the lathe. At 2 o'clock the motor was started, as indicated by the increase of power, and ran idle for a short interval while the tool was being adjusted. At *a* there was a sudden increase in power indicating that the tool was cutting. While the shaft was turned off from *a* to *b* the pen marked *ab* on the record. At *b* the power decreased to no load because the feed on the tool was shut off in order to adjust the cutting tool to a larger diameter as required. Cutting began again and continued to *c*, but the power was less than at *ab* since less metal was being removed. At *c* the diameter was again changed in order to take the cut *cd*, and at *d* another change was made for cut *dc*.

At about 2.20 the motor was shut down for the interval marked "Reverse." The shaft was half completed and was removed from the chuck, turned about and the opposite end was replaced in the chuck in order to cut from *j* to *e*. The interval during which the motor took no current, from 2.20 to 2.29, showed that 9 minutes were required to reverse the shaft.

After the motor was again started, the cutting was continued until the shaft was completed, cutting *jh*, *hg*, *gf*, *fe* and finally *ji*. The shaft was removed during the interval marked "Change" and replaced by a new piece of stock, after which the cycle of operations was begun on the next shaft.

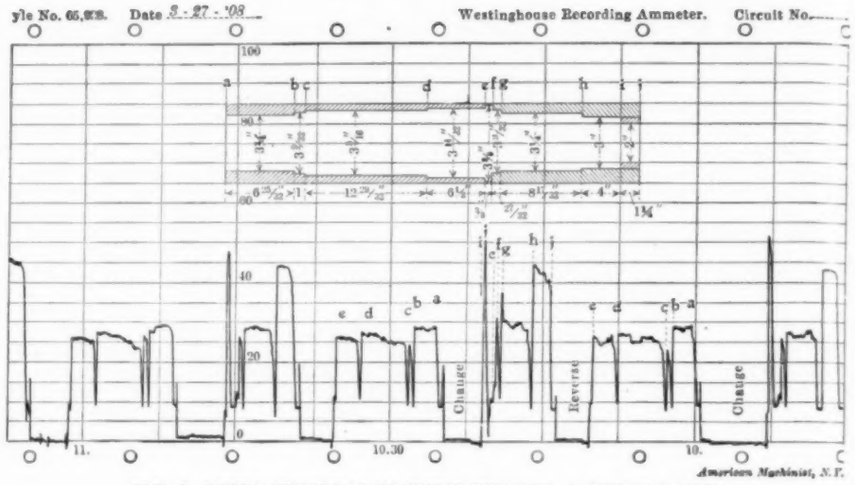


FIG. 3. METER CURVE TAKEN WHEN TURNING A MEDIUM-SIZED SHAFT IN A ROUGHING LATHE

	1	2	3	4	5	6	7	8	9
Shaft No.	Cutting Time in Minutes.					Intervals Between Cuts in Minutes.			Time in Minutes Complete.
	ab	*bc*	*de*	*dc*	Total.	Change Shaft.	Reverse Shaft.	Adjust Tool.	
1	2.3	1.5	1.7	2.6	8.1	1.4	1.7	1.1	12.3
2	2.4	1.4	1.7	2.6	8.1	12.1	2.8	6.7	29.7
3	2.2	1.5	1.7	2.6	8.0	1.4	1.4	1.4	12.2
4	2.1	1.4	1.7	2.6	7.8	1.7	1.7	1.4	12.6
5	2.1	1.4	1.6	2.6	7.7	1.7	1.7	1.5	12.6

TABLE 1. ANALYSIS OF TIME CONSUMED IN MACHINING SHAFTS.

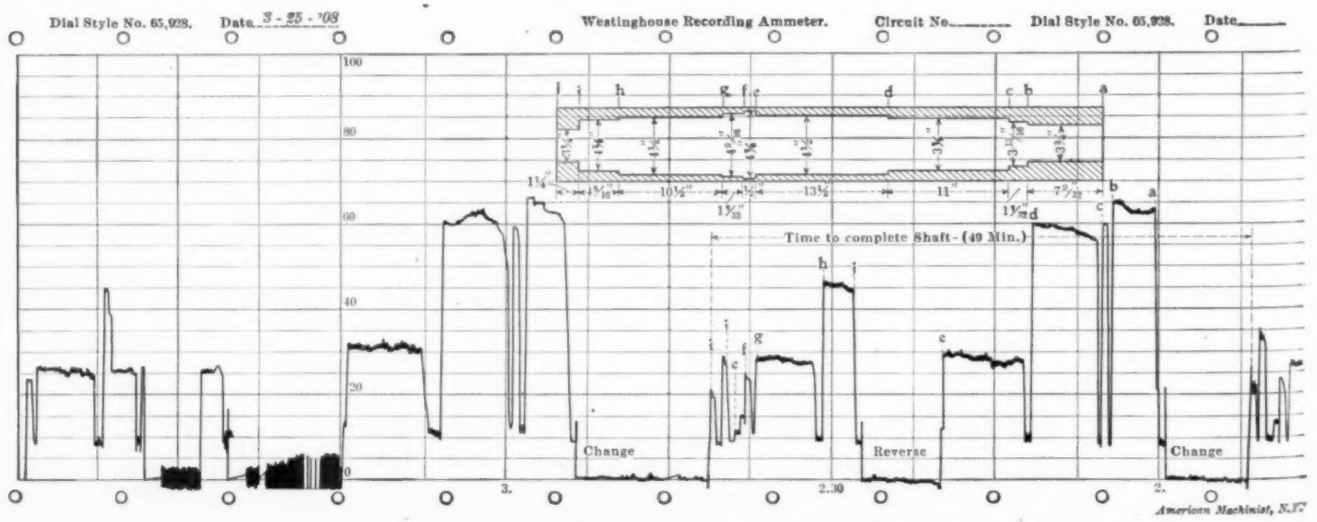


FIG. 2. TYPICAL METER CURVE TAKEN WHEN ROUGHING A STEEL SHAFT IN AN ENGINE LATHE

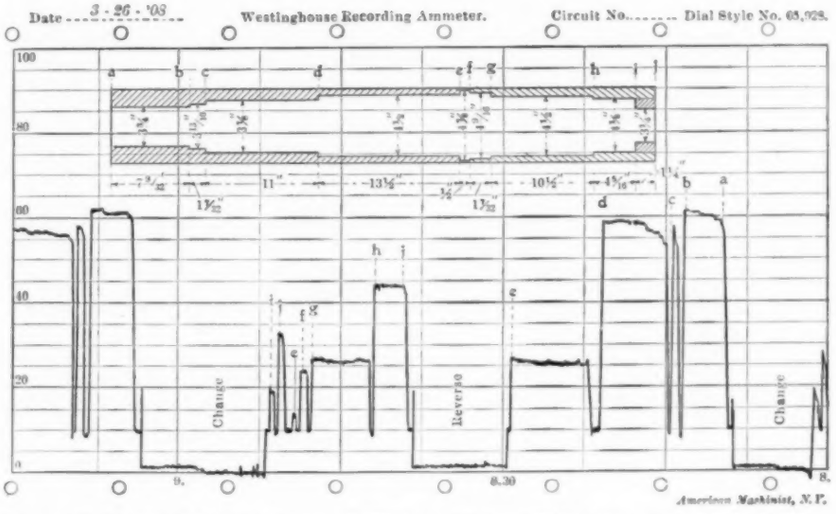


FIG. 4. METER CURVE TAKEN WHEN TURNING A HEAVY SHAFT IN A ROUGHING LATHE

Analysis of the Meter Curves

Table 1 shows how accurately an operation of the above type can be analyzed into the items of time.

Columns 1 to 4 give the time required in minutes to make each cut. Column 5 is the total of these or the total cutting time. Column 6 is the time required to change the shaft; Column 7 shows the time required to reverse the shaft. The time required to adjust the cutting tool is given in Column 8. This is the sum of the small intervals between the cuts. The last column is the total time required to complete the shaft.

In case of shaft No. 2 it will be noted that the time to change shafts and to adjust the tool is greater than in any other case. This is due to grinding the tool, which caused 10 minutes delay in the time to change shafts. The tool had to be adjusted to the proper angle with respect to the work in the tool rest; this took 6.7 minutes for adjustment, which is 5 minutes greater than the average figures for this operation.

Tests have shown that with a given type of cutting tool the power required to cut metal increases in direct proportion to the amount of metal removed per minute; hence, the excess above the power required to run the machine idle is an indication of the rate of cutting.

From the information obtained by graphic records of the above type it is possible to compare the operation of different classes of work on the same tool or the performance of different types of tools on the same work, by a simple but accurate means.

The Meter Curves Often Show up Unsuspected Conditions

The following examples will illustrate the use of the meter and show how its records showed up conditions not known to exist before the records were obtained. The record shown in Fig. 3 was taken while turning a medium-sized shaft on a roughing lathe. The shaft was light enough to be handled by hand. Fig. 4 is a similar record taken while a heavier shaft was roughed out on the same machine. It will be noted that the time required to make the reversals and changes, indicated by the periods marked "Change" and "Reverse," was shorter in the case of Fig. 3 than in Fig. 4. Upon investigation it was found that the longer intervals in Fig. 4 were due to delay in waiting for overhead traveling-crane service.

The average of several days' curves taken on the two jobs showed that the "Change" and "Reverse" periods were each five minutes longer in the case of the heavier shaft, or 10 minutes' delay was caused on each due to lack of proper crane service. The time required to complete the larger shaft was 55 minutes. By eliminating the 10 minutes' delay, this could be reduced to 45 minutes, effecting a saving of time and cost of about 20 per cent.

This condition was remedied by installing a jib crane beside the lathe, so that a shaft can be changed as soon as completed. The change results in a completion of two more shafts per 10-hour day. On the lathe in question the daily overhead charge was $6 and the workman received $3.50, making a total of $9.50 per day. The 20 per cent. saving amounts to $1.90 per day on that particular job. The cost of the meter installed is approximately $125, hence by the saving on the one job alone the meter will be paid for in 65 working days. In a busy shop there are many such delays which are overlooked since the men in charge have no means of discovering them. They are kept too busy with other matters to see such delays, self-evident as they may seem after being known.

Use of Meter in Determining Most Economical Cutting Speed

Besides eliminating all unnecessary delays between the cutting operations it is absolutely necessary to use the proper rate of cutting for most economical production. The rate of cutting depends upon the depth of cut, which is usually fixed, the feed and the cutting speed. The feed and cutting speed can be varied. The proper value for these depends upon the nature of the work, the cutting tool employed and also the strength of the machine tool. A small feed with high cutting speed usually requires more frequent grinding of tools than a coarser feed at a slower speed. Thus there are more delays due to removing and grinding tools. By means of the recording meter it is possible to record all delays and cutting periods over several days' operation, and in this way the effects of different rates of cutting upon output may be investigated and the most efficient conditions determined under actual shop conditions.

Figs. 5 and 6 illustrate the effect of doubling the rate of cutting on a given piece of work as shown by the meter. In Fig. 5 the cutting speed was 80 to 90 feet per minute and in Fig. 6, 40 feet per min-

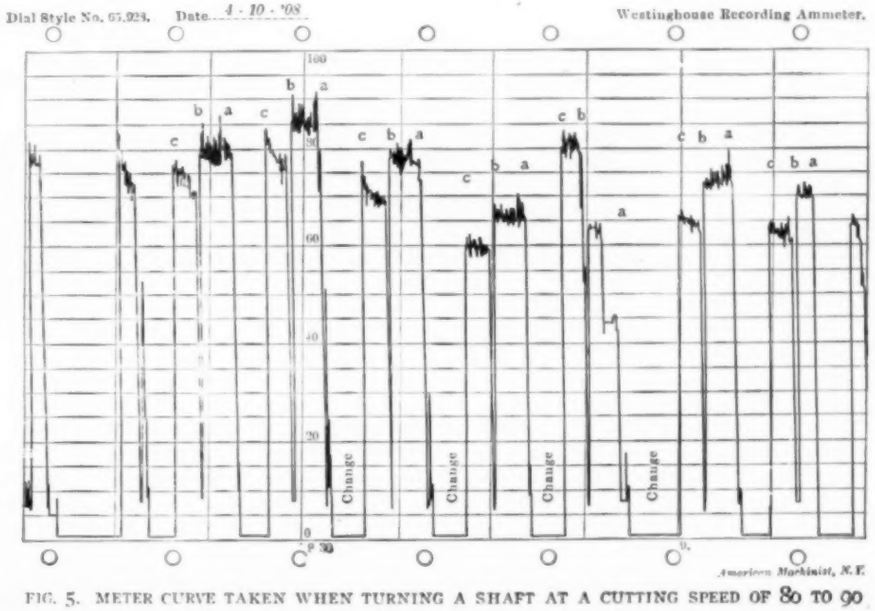


FIG. 5. METER CURVE TAKEN WHEN TURNING A SHAFT AT A CUTTING SPEED OF 80 TO 90 FEET PER MINUTE

ute, the feed being the same in both cases. The saving in time by the higher rate of cutting is made very striking and convincing by the graphic record. With a little practice the rate of cutting can be determined directly from the record. For instance, the two rates of cutting and the time required in each case are represented very closely in Figs. 5 and 6 by the relative hights of the curves and the widths of the portions showing corresponding operations.

Use of Meter in Comparing Effectiveness of Different Machines on Same Work

The following example will show how the meter can be used to compare the time to do the same operation on different types of machines, as for instance, to determine whether a milling machine or a slotter will do a given piece of work in the shorter time. Several records were obtained from two such machines cutting the same material over a period of several days. Both tools were of the portable type and were set up to cut the complete number of slots in a generator frame with one setting of the machine tool. The graphic records made by the two machines showed the following results:

	Size of Slots, Inches.	Cutting Time, Minutes.	Minutes to Cut One Inch.
Miller.....	7⅛ x ⅝ x 12½	11.8	0.95
Slotter.....	7⅛ x ⅝ x 15¾	8.4	0.53

TABLE 2. ANALYSIS OF CUTTING TIMES OF MILLER AND SLOTTER ON SAME WORK.

The actual cutting time per inch of the slotter was only 56 per cent. of the time of the miller, and both tools were removing exactly the same amount of material. The intervals required for the adjustment of the positions of the tools from one slot to another averaged 6.1 minutes on the miller and 3.1 minutes on the slotter, or an average of 50 per cent. in favor of the slotter. The time to set up the work must be included to determine the relative advantage of one machine over the other. The setting up time was found to depend mostly on the work and neither tool had an advantage. Each machine was idle two hours, during which period the jobs were being set up. The results may then be summarized by comparing the operations of the machines in cutting two similar jobs of 12 slots 10 inches long. See table 3.

	Set Up.	Adjustments.	Cutting Slots.	Total.
Miller.....	2 hours.	1 hour, 12 minutes.	1 hour, 44 minutes.	4 hours, 56 minutes.
Slotter.....	2 hours.	0 hour, 36 minutes.	1 hour, 4 minutes.	3 hours, 40 minutes.

TABLE 3. ANALYSIS OF TOTAL MACHINE TIME OF MILLER AND SLOTTER ON SAME WORK.

1	2	3	4	5	6	7	8	9
	Record No.	Time Factor.	Average Running Load.		Maximum Load.		Average Kw. per Hour.	Load Factor.
			Kw.	Per Cent. Full Load.	Kw.	Per Cent. Full Load.		
72" Mill.	1	35	1.8	21	7.7	90	0.63	7.5
	2	56	2.0	24	8.8	103	1.1	13.5
	3	62	2.8	33	8.8	103	1.7	20.5
	4	46	2.8	33	6.6	78	1.3	15.0
	5	28	2.2	26	7.7	90	0.62	7.5
	6	37	2.2	26	8.3	98	0.81	9.5
	Average	44	2.3	27	8.0	94	1.0	12.0
36"-24 Mill.	7	59	6.6	33	18.0	90	3.9	19.5
	8	70	7.0	35	20.0	100	4.8	25.0
	9	60	7.0	35	15.5	78	4.2	21.0
	Average	63	6.9	34	17.8	89	4.3	22.0

TABLE 4. ANALYSIS OF OPERATION OF BORING MILLS.

This shows that the total time required by the slotter was but 74 per cent. of that required by the miller, or a saving of 1 hour and 16 minutes on every such job.

Determination of "Time Factor"

An important factor in the operation of machine tools is the percentage of the total working hours which the tool is actually cutting.

This percentage will be called "Time Factor." The lower this percentage, the greater the number of idle periods in the performance of the machine and unnecessary delays very likely occur in some part of the operation. Table 4 is based on records taken on motor-driven boring mills and shows in detail the operating conditions of this type of machine in a large shop.

Column 1 indicates the size of the boring mill. Column 2 refers to the number of the record taken by the graphic meter. In Column 3 are the time factors obtained from the records. These percentages vary from 28 to 62 per cent. on the smaller mill. The higher percentages are due to jobs which have cutting operations extremely long compared with the time required to set up the job. On the other hand the low time factors indicate setting-up time in proportion to the cutting time. The setting-up time includes the time required to remove a completed job, clean table of chips, wait for crane service, bolt and center the new casting on the table of the mill ready for the cut; all delays which may occur in obtaining cutting tools, drawings, or other materials are included. The time required to make adjustments of the cutting tools between cuts also reduced the time factor, amounting in the majority of cases to about 10 per cent. of the complete time.

The remaining columns show the operating conditions of the driving motor. The average kilowatts per hour is the total

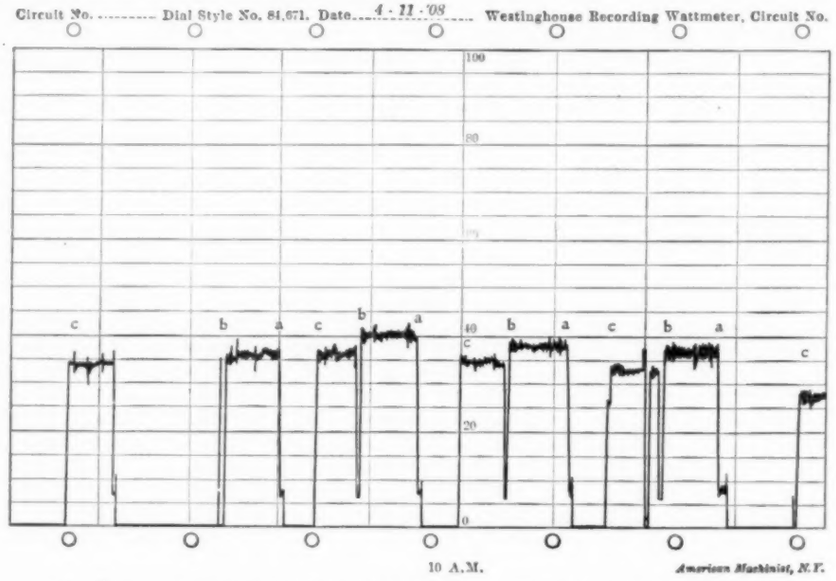


FIG. 6. METER CURVE TAKEN WHEN TURNING A SHAFT AT A CUTTING SPEED OF 40 FEET PER MINUTE

power consumed divided by the total number of working hours and affords a basis for calculating the power bill. On the 72-inch mill the average is 1 kilowatt per hour, and for a working day of 10 hours, the power bill will be 10 kilowatt hours times the rate per kilowatt hour. The last column expresses this average load in percentage of the name-plate rating of the motor and is termed the "Load Factor."

It is obvious that the data above tabulated show in detail just how long the mill is cutting and standing still and also show just what power is required per day while performing the regular shop operations. The shop manager thus learns details which are impossible to obtain in any other practical way. Fig. 7 shows a typical record obtained on one of the above boring mills. The idle spots are at once evident and definitely located. By seeking an explanation for each of them experience has shown that a large percentage can be reduced and even eliminated by changing the methods of handling the necessary materials.

Analysis of a Long Machining Operation

Table 5 shows how the time of a long machining operation was analyzed by means of the graphic meter. A large cast-iron generator frame of about 18-foot bore was machined on a 28-foot boring mill, both the setting up time and the cutting time being of long duration. The meter shows the rate of cutting at all times.

Operation.	Time.	Per Cent. of Completing Time.
Set up.....	13 hours, 7 minutes.	38.2
Cutting.....	17 hours, 49 minutes.	51.5
Adjusting tools..	3 hours, 34 minutes.	10.3
Total.....	34 hours, 30 minutes.	

TABLE 5. ANALYSIS OF MACHINING OPERATIONS OF AN 18-FOOT GENERATOR FRAME ON A BORING MILL.

All the above illustrations show that the graphic meter affords a means of analyzing the most complicated machining operations in a simple way. Unknown delays are not only uncovered, but they are definitely located, thus providing a means of increasing production on a given equipment without making any expensive changes.

Results obtained with case-hardened pinions were discussed in a report recently presented to a tramway association in England. In the report it was pointed out that the average car mileage of these pinions was slightly over 110,000 miles each, whereas the life of the unhardened pinion was only from 19,000 to 20,000 miles. The life of the ordinary cast-steel gear wheels meshing with the case-hardened pinion was also improved. The steel which gave the best results for pinions contained 0.15 of carbon and 0.02 silicon, the sulphur and phosphorus being limited to 0.05 per cent. The pinions were case-hardened to a depth of not less than 1/16 in. from the surface of the teeth, the center being left soft.

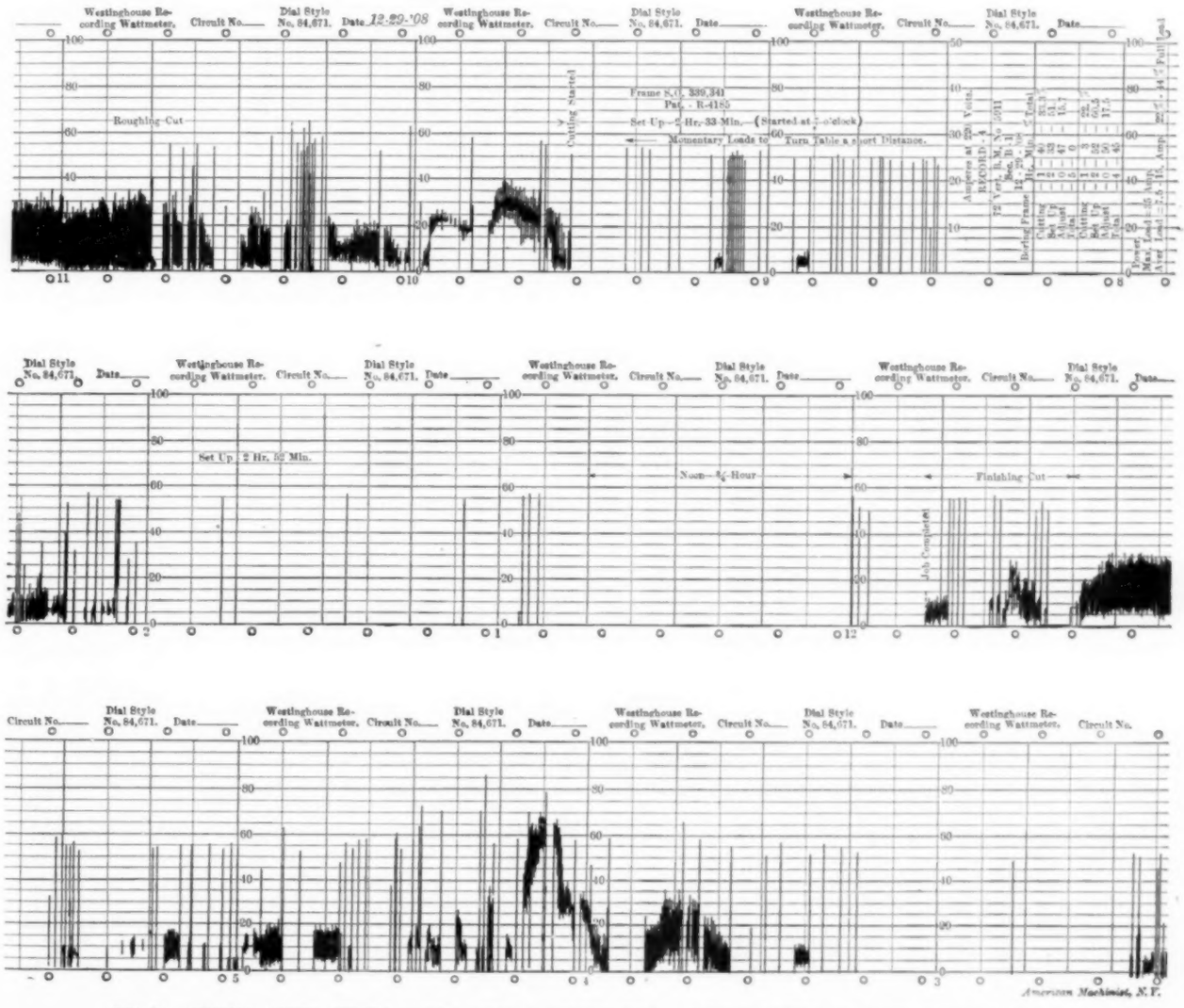


FIG. 7. TYPICAL METER CURVES TAKEN FROM A BORING MILL. (CURVE BEGINS IN UPPER RIGHT-HAND CORNER AND READS TO THE LEFT)

Echoes from the Oil Country—Who Can Tell the Commercial Effect of Odors?

By W. Osborne

It would seem as though almost all sides of the shop questions have been discussed at some time or another, but there is one point that so far as my reading has gone seems to have been entirely overlooked.

Did it ever occur to you that every shop has its own individual odor, and that this odor might have an effect on the work turned out?

We all have had experience with vile odors caused by abnormal conditions which are only temporary. In one such case a workman was annoyed by a very disagreeable smell that he could not locate amidst the numerous regular smells of the shop. This smell was so persistent that it took his attention from his work, and the foreman had to remind him that the purpose of his being in the shop was to get out work. This led the man to tell the foreman about the odor which by this time he blamed on some of his fellow workmen who he thought were putting something on the machine to produce it. He thought it smelt like limberger cheese. The foreman told him to take time to thoroughly clean up the machine and its surroundings and then to get down to business. While this was being done a rat was found in the base of the machine and as it was in an advanced state of decomposition it was "high" enough to account for all of the unusual odor. Almost any normal man is "fine haired" enough to have such an odor as that interfere somewhat with his "efficiency curve."

One machinist used to say that when he was working with cast iron where he had to use oil it always made him think of the time when some of the children in a country school got the itch and as a matter of precaution his mother made him take a lot of sulphur mixed with molasses. He was never able to arouse any enthusiasm over a job that smelled like that.

We may be so familiar with the smells of our shops that we do not notice them but most of us readily notice the various ones in strange shops, but whether we notice them or not there is not any question about shops being full of them. It is one of the things that it seems that we always knew that certain odors do produce a very powerful effect on the feelings. The smell of some things produces at once a feeling of hunger, while that of other things produces nausea. The smell of most flowers produces a pleasure difficult to define but which tends to make us want to linger near the source, while the smell of a skunk is far from pleasant and makes us want to move from the vicinity tainted with it. There are smells that irritate us and there are others that sooth.

While we recognize the ones which have the greatest effects on us is it not reasonable to suppose that every smell has some effect? If this is true, might it not also be true that certain ones would have an influence on most men which would make a commercial difference in the results obtained when they were present as compared to those obtained when they were absent?

It may be that when any person is subjected to the influence of a smell for continued lengths of time he becomes immune as far as its influences go, and if this should be so it would not be of any lasting benefit to perfume our shops unless we kept changing the perfumes frequently, and it may thus come about that we shall come to have professors of odors at some time in the future.

In speaking about the shop odors I am not intending to take in the ones that belong more properly under the classification of stinks. Most if not all of these are preventable and their existence are a reflection on the management of the shop in which they are found. The odors that I would speak of as distinctly shop smells are those which come from the materials used. Metals give off smells in being worked. So do woods, oils, paints and many other things, and these blending produce a compound odor. If the output is uniform this odor may become fairly well established. A change of material or of methods may vary it to a very noticeable extent. The odor and the variations are likely to be more noticeable to one who is only intermittently in the room than they are to one who is there continuously throughout the day. I think that there are some odors which are strong enough and disagreeable enough to interfere with business. As an illustration I will mention a stove polish that makes a stove look very pretty. When the stove is first heated up after it is applied the resulting smell is such that those who can, leave the house, and those who cannot, wish that they could. As a domestic polish for winter use I do not expect that polish to become popular. There is a liquid that smells like decaying bananas. It is useful for mixing with bronzing powders but the smell is both penetrating and lasting and it is very disagreeable to most people, so much so that at least one shop made several trials to find something that would take its place. Men working near where it was used complained of headache and rebelling stomachs.

It may be that the product of a shop carries an odor with it that may influence the public. I can think of one such odor at present. I sometimes receive advertising matter of a high grade that brings with it a smell that makes it receive a very brief and distant reception. I cannot tell whether this smell comes from the binding, the paper, the illustration or the reading matter, but to me it is so intensely disagreeable that I cannot tolerate it, and most of the matter that comes with it as an attendant goes into the waste basket without being read. I have received sample copies of magazines that carried the smell and not only have I not been tempted to subscribe for them but I would not accept a subscription as a gift. There is one thing about this smell, and that is that it comes on high-grade work and never on the cheap work. It may be that it is an indispensable part of some new process, but if it is and that smell is as disagreeable to the rest of the human race as it is to me some improving will have to be done before it will be a "go." Fortunately it is not attached to my favorite reading matter, and I hope that it never will be or I may be obliged to invent some way of reading at about a ten-foot range, or else hire someone who is not so susceptible to do my reading for me. I realize that some reading must be done regardless of smells or other inconveniences for without it progress ceases, although up to now the literature with the disagreeable odor has not been indispensable.

I wish that I had a way of describing this odor so that others could recognize it for I would like to know what it comes from and what excuse it has for being there, and find out whether it is as disagreeable to others as it has been to me.

There is a cup grease that has an odor that I cannot describe any better than to say that it is an appetizing odor. The cup grease is good and so is the smell. I have often wondered what it was that gave it such a nice smell for I had always supposed that cup greases belonged in the soap family. One day a friend who is in the oil and grease business called on me and I dug for information. I found that the ingredient that produced the odor was a very necessary part of the compound although it did not have any other office than to make it smell attractive, "but," said my friend, "it is that smell that sells it. There is one thing in the grease that must be used to make it and that thing stinks so badly that we couldn't give it away unless we scented it with something."

It will not do to say that all odors that are disagreeable are unwholesome, meaning that they are poisonous, for such is not the case, but there is not any question about a disagreeable odor being disturbing enough to attract the attention even from music or a sermon. If it is powerful enough to make one feel like doing something rash even under refined surroundings, who can doubt its influences in shop surroundings Perhaps even now some genius has been experimenting and soon I will be approached by a salesman who will furnish an odor that will make profit sharing, the premium system, and all such like schemes entirely unnecessary.

Who can tell?

The Machining of an Automobile Cylinder

By James McIntosh

The machining of an automobile cylinder has been given much study and several methods have been tried to secure uniform results. The conditions under which a cylinder has to operate are such that the methods used in order to obtain a finished cylinder are very important, and if the design is not favorable the results of any method may be good work wasted. It might be well to define what design has to do with the final results obtained even with the most accurate machine work possible.

In the first place the conditions under which a cylinder has to operate are severe and as the heat is generated at the head end, there is a chance for unequal expansion to change the shape of the cylinder. It is, therefore, very essential that no surplus metal be allowed in contact with the bore and valve seats and that all points in contact with the heat of explosion be of even thickness of metal. Provision should be made to absorb the heat at all points so that uniform expansion of the metal will result. It is also very essential that the metal of the bore be regular, for if a misplaced jacket core causes the thickness of the finished cylinder-bore wall to be irregular, we cannot expect the expansion to be uniform.

Annealing the Castings

The question arises as to its being advisable to anneal the casting before or during the process of machining, say, after the casting has been roughed up. Personally I do not favor the process at any stage of the machining. When we consider the casting has to be heated and cooled in the annealing process the chances are the heat will not act alike at all points and the same will apply as to the cooling process. It may eliminate hard spots, but be the means of causing internal strains that did not exist before the process. I consider an iron casting if allowed to cool in the mold has every chance to do a good job of annealing, and any attempt to improve on it will be less satisfactory.

The next question that arises is what is to be gained by finishing the bore by grinding and when shall the best results be obtained? The result of grinding will mean a cheaper method of holding a standard size with a smoother bore compared with any method of reaming I know of, but as to when the bore should be ground is, to my mind, very important. The usual plan is to let the cylinder cool off before finishing either when grinding or final reaming so that the heat generated due to the roughing cuts will be eliminated. If a true bore is desired when the cylinder is cold, then I say, amen. But the chances are that if a finished cylinder bore is hot, due to cutting, and any change takes place as a result, the cylinder will be nearly the same as if the heat was due to working conditions in an engine, as the heat is applied from the inside and acts directly on the bore, and a more satisfactory bore the result.

The Ideal Condition

The ideal condition would be to finish the bore with the cylinder at its working temperature, but that being impossible, we may be safe in assuming the nearest approach to that condition as best. The adoption of such a method is practical, for if the capacity of the boring mill is equal to the grinder and results are to be obtained by regulating the speed of both so that the one can handle the output of the other, there would be nothing gained by letting the cylinders bored get ahead of the grinder. Even if there was a cold cylinder ground every morning, the result would not be any worse than it perhaps is if the precaution were not taken. What we are aiming at is to get ideal conditions; if that can be accomplished the results will be.

Finishing by Reaming

Some concerns prefer to finish by reaming, believing the cylinder piston and rings will come to a bearing sooner. There is no question as to that claim; if wearing is a virtue time might be saved by lapping the cylinder and piston with some abrasive substance, but to resort to that process to correct defective methods is out of keeping with the intent of this article. I do not claim that a cylinder that is ground must be better than one that has been finished by reaming, but if a cylinder is ground after it has cooled the chances are the cylinder that is carefully bored and reamed will be better.

The trouble with the latter method is that too much is expected of the reaming. The first rougher is not considered as important and its defects will be left to the second to correct, and then the reamer must correct all the defects due to previous cuts. That, more than any other cause, has been the reason why some concerns cannot finish a true bore without grinding. The first essential to get a true bore is to have a suitable machine that will hold the job rigidly, a suitable fixture to prevent cramping of the cylinder, and suitable boring heads kept in good condition, each to do their share of the work so that all is not left to the reamer.

Boring-head Suggestions

It may be asked, what are the most suitable boring heads to use? A head with multiple cutters so arranged that the tools can be readily adjusted and ground so that all will do their share of the cutting. The number of tools are optional, but are better an even number so that they can be calipered if three heads are to be used (and that is the least number with which to get results). They can to advantage have a different number of tools in each case so that one cannot readily take up the irregularities and follow them. If, for instance, we start off with four tools in the first head, the second with six tools will not mesh with the points of contact of the first rougher, and if the reamer has eight tools it will not mesh with the irregularities of the second head. The reamer may be further improved by placing the blades alternately right and left, slightly spiral, so that the blades will eliminate any tendency to chatter or follow in the track of previous cuts. The importance of each cutter head doing its share will be evident for if the first cut means heavy cutting and irregularities, due to rough core the chances are that the next will have to take up the irregularity, and to a certain extent the reamer as well. If through neglect the heads are permitted to get dull, the results will be aggravated and the reamer instead of being a sizing tool with a light cut, is compelled to take up the irregularities due to previous cuts and eventually loses its size while the quality of work will be seriously impaired.

The Toggle Joint

By H. Terhune

Many designers seem to have a vague idea of the toggle joint, and when one comes up in their design they figure it (if at all) from one of the many formulas found in hand or textbooks, hardly any two alike, and about as reliable as the stock market during a panic. Kent, the family Bible of the mechanic, comes about as near to it as any when it states that $R : P :: cos.\ a : 2\ sin.\ a$ (two struts),

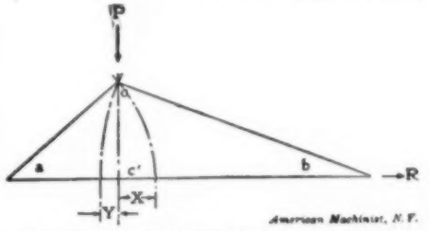


FIG. 1. DIAGRAMS OF FORCES OF A TOGGLE JOINT

of equal length, a being the included angle as in Fig. 1.

I can see no more logical way to treat such a problem than as a combination of levers, the force passing through a certain distance being equal to the resistance through a certain distance. This is best explained by the diagram and formula

$$P = \frac{R\ (versed\ sin.\ a + versed\ sin.\ b)}{sin.\ a},$$

where P is equal to the force and R the resistance.

One can at once see that the force P will pass through a distance $c\,c'$, while the resistance will pass through but $x + y$.

Autogenous Welding of Metals*

Apparatus Used for Oxy-Actylene Welding. Manufacture of Gases, Welding Steel, Cast, Wrought and Malleable Iron, Brass and Aluminum

BY C. B. AUEL†

Since the advent of high-speed steels one of the most important advances, to the engineering industries at large, is the development of autogenous welding. By this is meant the fusing together without pressure of two metals, simply by allowing them to melt, then to mix and unite as they cool. While this can be accomplished in several ways, by electricity, by oxy-hydrogen, by oxy-gas, or by oxy-acetylene, the last mentioned is beginning to be quite generally understood when reference is made to this kind of welding.

Eliminating consideration of electrical methods, the apparatus, briefly outlined, includes a suitable blowpipe with facilities for obtaining a supply of oxygen and either hydrogen, coal gas, or acetylene, the blowpipe differing somewhat with each of the three combustible gases. Such outfits for use with oxygen and hydrogen have been familiar for many years in laboratories where, however, almost their sole function has been the reduction of elements rather than the welding of metals.

The quite recent development of commercial methods for making oxygen has now broadened the field of usefulness of this apparatus by placing within reach of practically all engineering industries, a simple and very inexpensive means of joining together similar metals, largely effected, heretofore, by the more complicated and less satisfactory processes of riveting or brazing. In addition, new methods of manufacture have been introduced along many lines and the repairing of broken or defective parts has become an industry in itself.

Apparatus and Blowpipe

Considering only the oxy-acetylene process and describing the apparatus more in detail, it consists, in its common form, as shown in Fig. 1, of a blowpipe, a tank containing oxygen under pressure, an acetylene generator and its storage reservoir, together with suitable valves and hose. A more complete outfit comprises a generator and a tank for the manufacture and the subsequent storage of the oxygen. This equipment may be still further amplified by the addition of a compressor for reaching higher pressures, where necessary, than can be obtained from the oxygen generator direct.

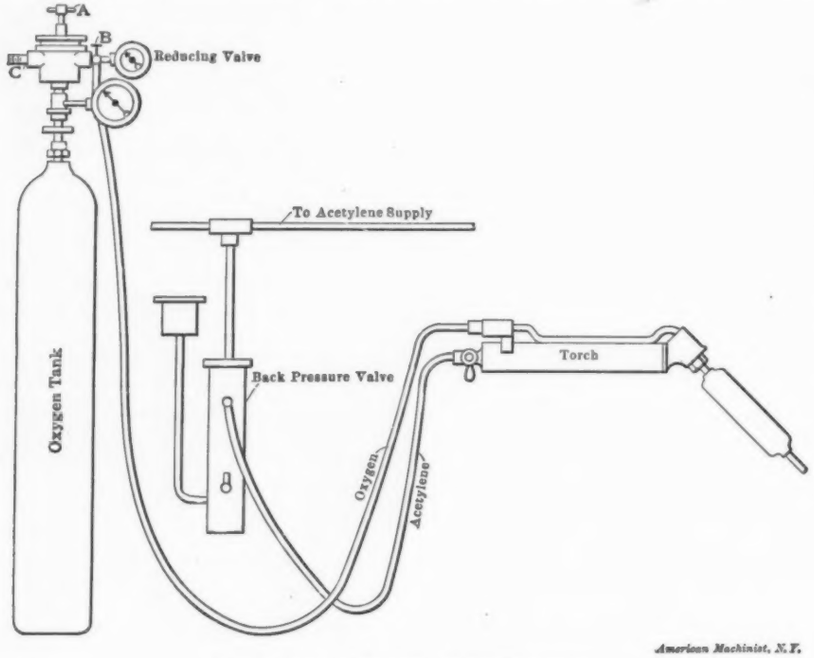


FIG. 1. OXY-ACETYLENE WELDING OUTFIT

The French must be given credit for the development of the first commercially successful oxy-acetylene blowpipe or torch. In 1901, Fouché and Picard exhibited before various French societies, a torch in which both gases were supplied under high pressure, the acetylene being diluted with gasolene or ether to aid in preventing "back-fire."

In 1902, Fouché succeeded in developing a high-pressure torch in which the oxygen could be used with the acetylene undiluted. Practical use of this type of torch, however, soon indicated an inherent defect, in that the pressure of the issuing gases tended to blow away the metal from the weld as fast as melted. This difficulty accordingly led to the further development, also by Fouché (1903), of the present low-pressure torch now so largely employed.

Nozzle and Flow of Gases

In this latter type, the oxygen is used under a pressure ranging from nine to thirty pounds depending upon the nature of the work, while the acetylene is supplied under a still lower pressure, varying from a few ounces to several pounds according to the style of torch, of which there are a number now being exploited. Figs. 2 and 3 show an exterior view and a longitudinal section respectively of one of these torches.

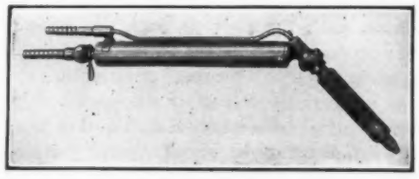


FIG. 2. FOUCHÉ WELDING TORCH, EXTERIOR VIEW

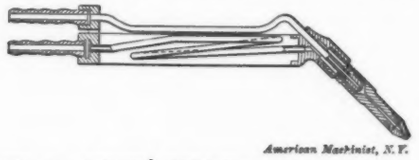


FIG. 3. FOUCHÉ WELDING TORCH, INTERIOR VIEW

The oxygen flows through the upper pipe directly into the torch to the small mixing chamber, the acetylene being conveyed separately through the lower pipe to the same place where the gases then mix and pass out at the nozzle or tip. As the velocity of the explosion wave is extremely high, the tendency to "back-fire" must be guarded against. By making the acetylene pipe as small in section and as long as possible, and further by giving to the oxygen a velocity of not less than 500 feet per second, this is effectually accomplished.

The capacity of a torch is determined by the orifice in the nozzle. In some

*From *The Electrical Journal.*

†Manager, railway department, Westinghouse Electric and Manufacturing Company.

makes the nozzle is accordingly removable and a number of different sizes are provided, these being readily interchangeable to suit the work; in others, the nozzle is fixed, a separate torch being required for each class of work. The former is the more flexible; but, where large quantities of any one kind of material are the rule, either torch may be used with equal advantage.

Temperature of Flame

From the equation for the complete combustion of acetylene

$$C_2H_2 + 2.5\ O_2 = 2\ CO_2 + H_2O,$$

it will be observed that two and one-half volumes of oxygen, O, are theoretically required to one volume of acetylene, C_2H_2, producing two volumes of carbon dioxide, CO_2, and one volume of water vapor, H_2O. The amount of oxygen actually consumed, however, is considerably less, it being variously stated as from one and one-tenth to one and eight-tenths volumes, to one of acetylene.

In explanation of this fact, it may be stated that the temperature of combustion is greatly in excess of that at which steam dissociates. As a result the hydrogen in the acetylene does not unite with the oxygen from the torch to form water vapor, as indicated in the preceding equation, but passes rather to the outer edge of the welding flame, where it comes into contact with the cooler surrounding air, extracts the oxygen from it, burning at a reduced temperature, and forming water vapor in so doing.

It is further probable that the combustion of the carbon is not always complete, so that the resulting mixture contains at times, in addition to the hydrogen, carbon monoxide and carbon dioxide gases. The welding flame proper is surrounded by an irregular semi-luminous, pink flame of lower temperature, which not only serves to protect it from loss of heat, but also tends to prevent oxidation of the metal when being melted, by keeping it to some extent from contact with the air.

Temperatures of Gases

Acetylene when burned in air gives rise to a relatively cool temperature of 1800 degrees Fahrenheit as compared with 2500 degrees for coal gas and 3500 degrees for hydrogen. If these were the highest temperatures attainable, neither acetylene nor coal gas would be especially suitable for welding; burned in oxygen, however, instead of in air, quite different results are obtained, particularly in the case of acetylene, which then gives a temperature of 6300 degrees Fahrenheit, or but a few hundred degrees less than that of the carbon electric arc, while under similar conditions coal gas gives 3000 degrees and hydrogen 4800 degrees. It is, of course, understood that the several temperatures mentioned are approximations only, as no exact determinations have yet been made.

These increased temperatures will be the more readily appreciated when it is remembered that air is composed of nitrogen and oxygen in the proportion by volume of 79 parts of the former to 21 parts of the latter. Since nitrogen is an inert gas, and forms such a greater proportion of the air, the heat of combustion is largely expended uselessly upon it, thus materially lowering the temperature of the flame; whereas when oxygen is substituted for air, this waste of heat is entirely avoided.

Calcium Carbide

Although acetylene was first produced in 1836 by Davy (Edmund) from a by-product obtained in the production of metallic potassium, and its further production direct from calcium carbide was announced by Woehler in 1862, it is exceedingly interesting to note that, outside of laboratory work, no use was made of this knowledge until 1892.

At this time Thomas Willson, an electrical engineer, while endeavoring to make metallic calcium from lime and coal tar, through the medium of the electric furnace, obtained a dark-colored slag which he placed in water in order to cool quickly, when it at once commenced giving off gas.

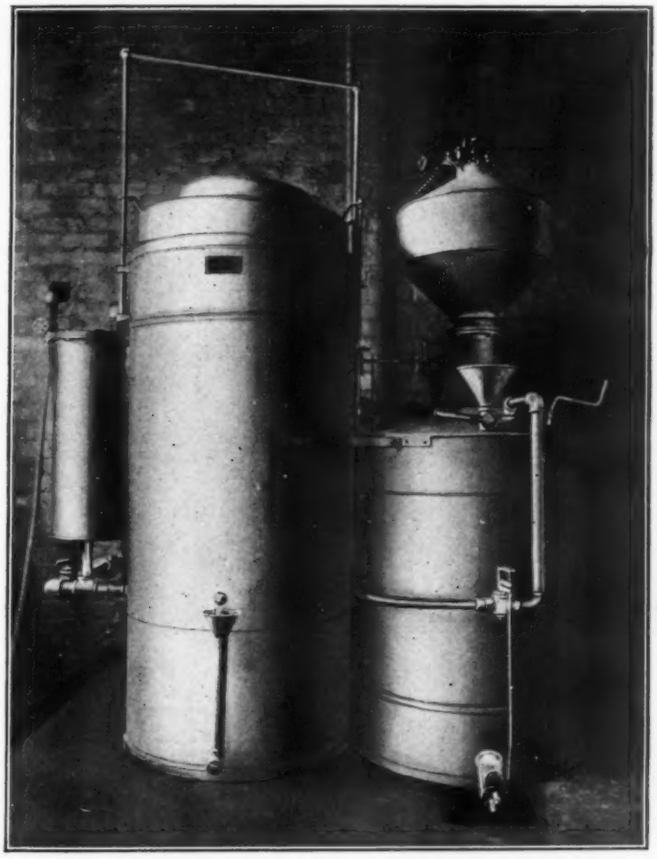


FIG. 4. ACETYLENE GENERATOR (MONARCH ACETYLENE COMPANY)

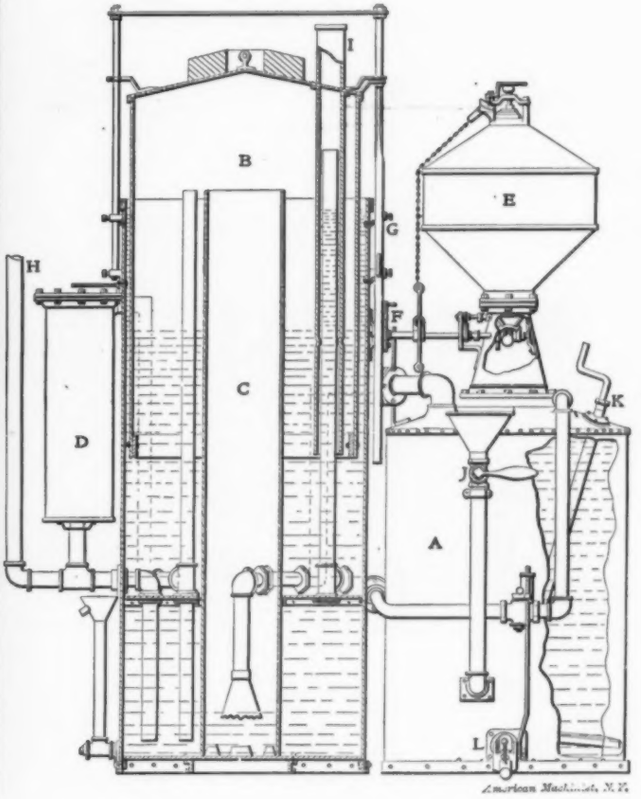


FIG. 5. SECTIONAL VIEW OF GENERATOR

It was thought at first the slag was the metallic calcium sought and the gas hydrogen. Upon igniting the gas, however, it burned with an intensely yellow flame accompanied by a large amount of soot. The experiment was repeated several times with like results.

Analysis then showed the slag to be calcium carbide and the gas acetylene. This general method, first outlined by Wilson, is followed today in the commercial production of calcium carbide, CaC_2; lime, CaO, and coke, C, being intimately mixed together and then fused in the electric furnace, the equation being,

$$CaO + 3\ C = CaC_2 + CO.$$

The resultant calcium carbide is a slag of a dark blue-gray color. When kept dry it undergoes no change whatever; and, in this condition, is absolutely safe to handle. Exposed to air, it absorbs moisture, gradually slaking and giving off acetylene, which last fact is readily evidenced by a peculiar onion-like odor. The gas is not actively poisonous when inhaled in small quantities.

Results of Combining Calcium Carbide with Air or Water

It is only when calcium carbide is wet that there is any possibility of its becoming dangerous; and then, only when the resulting gas is allowed to mix with air in a confined space. Mixtures of acetylene and air, between the limits by volume of 1 of the former and 1¼ to 20 of the latter, will explode with more or less violence when ignited; in which respect, however, it does not differ appreciably from common illuminating or any other combustible gas.

When, therefore, calcium carbide is brought into contact with water, acetylene is evolved, as indicated by the equation,

$$CaC_2 + 2\ H_2O = C_2H_2 + Ca(OH)_2$$

the by-product being slaked lime, $Ca(OH)_2$. As there are always certain impurities present, either in the carbide or in the resulting gas, such as carbon, sand, hydrogen sulphide, ammonia, etc., the yield of acetylene at atmospheric pressure from a pound of commercially pure lump calcium carbide ("quarter" size) may be taken as from 4 to 4½ cubic feet instead of 5½ cubic feet as would be the case were the carbide absolutely pure.

In the commercial manufacture of acetylene either of two methods may be followed; calcium carbide may be dropped into water, or water may be dropped upon carbide. Generators employing the former method are designated as "carbide-feed," those making use of the latter are known as "water-feed." In either of these types the gas may be generated at pressures ranging from 6 ounces to 15 pounds per square inch, depending upon the design.

Carbide-Feed Generator

While each has its advantages, the carbide-feed generator is the more widely used, especially in connection with oxy-acetylene welding plants. Figs. 4 and 5 show one form of such type. It consists of two principal parts, the generating tank *A* in which the acetylene is produced, and the reservoir or holder *C*, where it is stored.

The generating tank is provided at its top with a hopper *E* into which the charge of lump carbide is placed and from which it is fed, a little at a time, into the water with which the lower part of the tank is

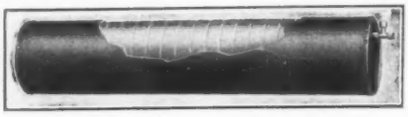


FIG. 6. DISSOLVED ACETYLENE STORAGE TANK

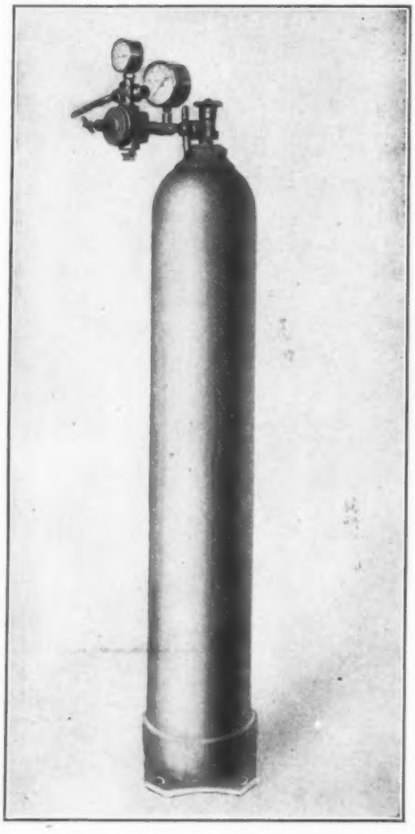


FIG. 7. OXYGEN STORAGE TANK, SHOWING PRESSURE REDUCING VALVE (LINDE AIR PRODUCTS COMPANY)

filled through the valve *J*. The residue, which settles in the bottom of generating tank *A*, can be stirred by turning the crank *K* which revolves an agitating paddle. The residue and waste water are discharged through the valve *L*.

The storage reservoir or gas holder is of the usual bell pattern, water-sealed, its top raising or lowering with increase or decrease of gas pressure, and operating in so doing, a simple mechanism of levers and cogs *F* and *G* by means of which the feeding of the carbide from the hopper on the generating tank is controlled. Although the water in which the acetylene is formed and through which it bubbles, acts as a cleanser, an additional filter *D* is provided in the shape of a small tank filled with felt, through which the gas passes after leaving the holder on its way to the service pipes. A safety blow-off *I* is also provided for the storage tank.

Water Feed Generator

In the water-feed generator the carbide is placed in trays arranged either one above the other, or side by side, in such manner that water floods them one at a time, the speed of flow being governed by the pressure of the gas. The acetylene then passes through a filter into the gas holder, which must be of larger capacity than for the corresponding size of carbide-feed generator, as the degree of regulation is never so close in generators of the water-feed type, and the holders must, therefore, be of sufficient size to handle the "after-generation" of gas; that is, the gas which continues to be produced for some time after the supply of water has been shut off by the rise in pressure.

The capacity of an acetylene generator depends upon its ability to keep down the heat which is evolved in the formation of the gas. This plainly indicates that an excess of water should at all times be present in the generating tank, so that the heat may be dissipated as fast as created. Where such is not the case overheating takes place, the result being not only a reduction in the amount of acetylene, otherwise usefully available, but the production of certain tar products which tend to clog the piping and thus prevent a proper working of the apparatus, particularly the torch.

As to whether or not the generator has been overworked is easily determined when cleaning it, which must be done upon the exhaustion of each charge of carbide. If the residuum which, as indicated by the equation already given, should be slaked lime, is of a yellowish color instead of white, it shows excessive heating has occurred and the necessary steps must be taken to prevent its recurrence.

Dissolved Acetylene

It is sometimes necessary to reverse the customary procedure and to transport the welding plant to the work instead of bringing the work to it. In all such cases, dissolved acetylene is used in place of the acetylene generator. It would, on first thought, appear as if compressed acetylene were the most natural substitute, but experience has proved that when compressed to more than two atmospheres (30 pounds) acetylene is liable to explode simply by concussion, and for this reason it cannot be used in commercial service.

To overcome this drawback and make it safe to handle, advantage has been taken

of its solubility in acetone, C_3H_6O, one of the constituents of wood alcohol, which has the very extraordinary property of absorbing, at normal temperature, approximately 25 times its own volume for every atmosphere of compression. It is accordingly forced into this liquid at 10 or 12 atmospheres and in this state is called dissolved acetylene. Even in this condition, the further precaution must be taken to prevent the accumulation of any "free" compressed gas, so called, into pockets.

The tank in which the dissolved acetylene is stored, is therefore packed, as shown in Fig. 6, with a porous material like charcoal cement or with disks made from a paste of asbestos fiber and sodium silicate, $Na_2Si_4O_9$, carefully prepared, so that even when thoroughly saturated with the liquid, no shrinkage of the packing can occur.

Volume of Acetone and Acetylene

The necessity of this is the more obvious when it is considered that the volume of the acetylene increases with the absorption of acetylene, at 12 atmospheres being about 1½ times its original volume. At this latter pressure it has been estimated (Kuchel) that the solution will occupy 64.3 per cent. of the interior of the tank, the packing 20 per cent. and the free compressed gas 15.7 per cent. When, therefore, acetylene is subsequently withdrawn from the tank, and the pressure correspondingly reduced, the acetone shrinks in volume with the result that a constantly enlarging space would be left for the accumulation of free compressed gas, were it not for the packing which effectually prevents it.

Manufactured and stored under such conditions, it is but natural that the cost of dissolved acetylene should be considerably in excess of the cost of acetylene, made and used direct from a generator. In partial compensation for this increased cost must be mentioned, however, not only its portability, but its low freezing point as well (It can be used at temperatures as low as —49 degrees Fahrenheit) which permit of its use under conditions quite beyond the range of the acetylene generator.

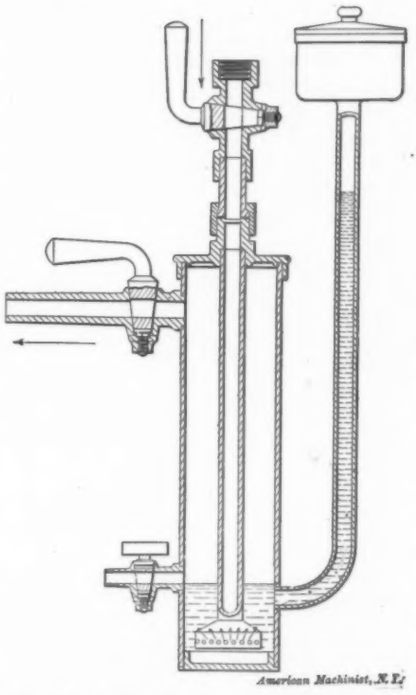


FIG. 8. ACETYLENE BACK PRESSURE VALVE (LINDE AIR PRODUCTS COMPANY)

To anyone contemplating the purchasing or handling of an acetylene plant, it is recommended that the rules of the National Board of Fire Underwriters be studied. These have been compiled with great care after years of experience and accordingly contain information which will prove of much value not only in the purchase but also in the installation and operation of the plant as well.

Oxygen

Oxygen may be produced in several ways, either from liquid air, by chemical agencies, or from the electrolysis of water; although this last method is but little used as yet commercially. Oxygen obtained in any of these ways is generally of a high degree of purity, varying from 95 per cent. to chemically pure.

A plant for its production from liquid air involves heavy initial expense, though the subsequent manufacture of the gas can be carried on at a very low figure. Such a plant, therefore, on account of its cost cannot be seriously considered by the average consumer and he has left the alternative of purchasing the compressed oxygen in portable tanks or making it himself by chemical means.

The apparatus for the generation of oxygen by chemical reaction consists of three parts, the generating tank, the scrubber or washing tank, and the storage reservoir, with sometimes the addition of a compressor.

FIG. 9. WELDING FLAME WITH GASES PROPERLY PROPORTIONED

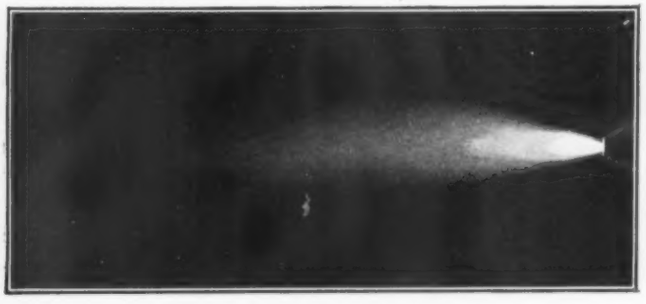


FIG. 10. WELDING FLAME WITH ACETYLENE IN EXCESS

FIG. 11. WELDER AT WORK

Dry Method of Producing Oxygen

In one method (dry) a mixture of chlorate of potash, $KClO_3$, and manganese dioxide, MnO_2, is placed in the generating tank, heat being then applied externally. In the ensuing reaction, shown by the equation,

$$8\,KClO_3 + MnO_2 = 8\,KCl + MnO_2 + 8\,O_3$$

oxygen is produced, passing as fast as formed into the scrubber.

This latter is a tank containing some substance such as pumice stone or pebbles, impervious to the action of the chemicals used, and which has been filled with an alkaline solution, usually caustic soda, NaOH. The oxygen in bubbling through is washed of any impurities and is then drawn into a compressor and pumped into tanks at any desired pressures.

A slight modification of this process, which eliminates the compressor, consists in first adding to the mixture of chlorate of potash and manganese dioxide, a certain amount of carbon, after which magnesium powder or a similar ingredient is introduced and ignited. The combustion is continued by means of the oxygen which is constantly being liberated until the reaction is complete.

The resulting gases, under a pressure of from 60 to 150 pounds go through a scrubber as before where the carbon dioxide (formed from the combustion of the carbon) and any other impurities are absorbed, the oxygen passing into the storage reservoir.

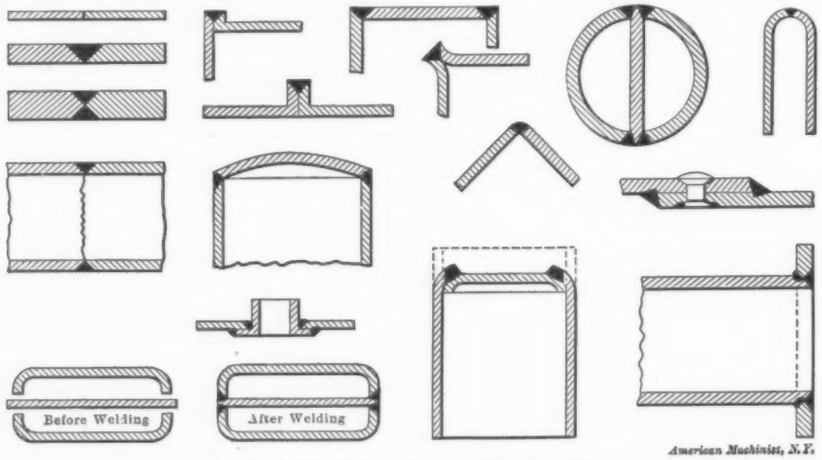


FIG. 12. DIFFERENT KINDS OF WELDED JOINTS

Wet Method

In another method (wet) a solution of iron sulphate, Fe_2SO_4, is allowed to flow into the generating tank where it combines in a complicated reaction with a solution of copper sulphate, $CuSO_4$, and calcium hypochlorite, CaO_2Cl_2, to form oxygen. The gas is washed as in the two preceding processes and then compressed.

It should at all times be borne in mind that oil forms an explosive compound with oxygen, so that it must not be employed as a lubricant either in connection with the compressor or with any of the valves. A mixture of castile soap and water should be used instead.

Oxygen Pressure Reducing Valve

In welding (not cutting) the oxygen is used in the torch between the limits of 9 and 30 pounds only; it is, therefore, necessary to reduce the pressure at which it is usually supplied and this is effected by a regulator, one form of which appears on the top of the oxygen tank in Figs. 1 and 7. Two gages are attached to it, as shown, the larger one indicating the pressure in the oxygen tank, the smaller one the pressure after passing through the regulator and as it is in the torch.

Adjustment of pressure is obtained by means of the thumb screw *B*, Fig. 1, while the set screw at the top *A*, shuts it off entirely. For the convenience of the operator, the larger gage is calibrated to show both pressure and cubical contents; the smaller gage to indicate the correct pressure to employ for each size of torch or nozzle. A safety-valve connecting with the low-pressure side is located at the left *C*, this being set to blow at a pressure slightly in excess of the highest normal working pressure.

Acetylene Pressure Reducing Back Pressure Valves

Acetylene may be generated, as before stated, at pressures varying from a few ounces to as high as 15 pounds, depending upon the make of generator. Except with the lowest pressures a reducing valve similar to the oxygen pressure-reducing valve is generally used which maintains the supply of acetylene constant at some pressure below the maximum.

From what has already been said, it is perfectly obvious that it is necessary to prevent either air or oxygen from passing back through the pipes into the acetylene generator. This is accomplished by an hydraulic valve, which operates as indicated in Fig. 8, the travel of the acetylene being normally in the direction of the arrows.

Should the generator be not working, or the nozzle of the torch be clogged, there would be a tendency for air in the first instance and oxygen in the second, to flow back into the generator. This, however, is prevented by the water in the valve, part of which, when the pressure is sufficiently high, is forced into the pipe leading to the generator, thus sealing it, while part is forced into the relief pipe to the chamber at the top where the pressure is released, the water falling back into the pipe.

Adjustment of Flame

In lighting the torch, the acetylene is first turned on and ignited, then the oxygen, the small gage on the oxygen tank being set to correspond with the size of torch or nozzle used. No further adjustment of the oxygen is necessary; the acetylene may, however, require some regulation, this being easily accomplished by the valve controlling the supply. In extinguishing the torch the acetylene is turned off, then the oxygen.

When the gases are properly proportioned, Fig. 9, a small intensely blue cone of flame is produced directly at the tip of the torch, being always accompanied by the enveloping, semi-luminous, pink flame, already described. An excess of acetylene, Fig. 10, is indicated by the formation of two small cones (plainly visible through colored glasses) one extending beyond the other, the light being very white; the metal is also carbonized and a deposit of carbon settles about the weld. Too much oxygen is indicated when sparks are given off freely, showing oxidation of the metal, and the flame takes on a violet tint which, however, is not easily distinguished; the weld has, further, a fine spongy appearance.

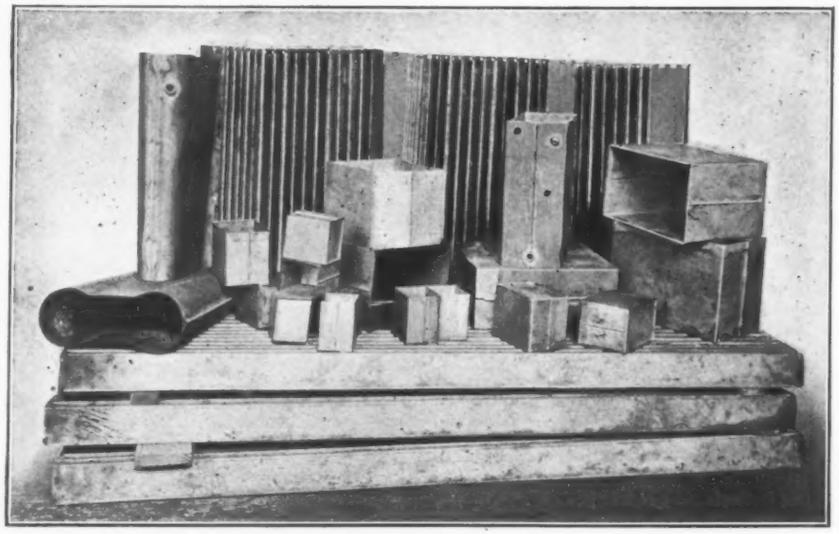


FIG. 13. WELDED SHEET-METAL TANKS

From the preceding it is quite evident that either a neutral, an oxidizing, or a reducing flame may be obtained as desired. Except in very special cases, a flame as nearly as possible neutral in character leaning, if anything, to the reducing, should be employed.

Welding

In welding, cleanliness is of the very first importance, and the necessity for this cannot be too strongly emphasized. It should permeate everything. Inability to obtain the best results may oftentimes be traced to impurities either in the chemicals used, or in the gases; it may also be due to carelessness in handling or caring for the apparatus, or it may even be the result of failure to clean the metal where the weld is to be made.

There is another and almost equally important point to which attention should be called, namely, the tendency to overdo welding. Owing to the comparative facility with which welds can be made, it not infrequently happens that repairs of this kind are effected on castings, etc., which should properly be consigned to the scrap pile and which would be, were the relative costs of repairs and new materials estimated in advance.

In Fig. 11 is shown a weld being made. It will be noted that no protection is needed for the operator except for the eyes, the process differing markedly in this respect from arc welding where the entire body must be covered. The workman holds the torch in one hand, the welding stick in the other, the two almost touching and practically forming an angle whose apex (including the blue cone of flame) is within 1/32 to 3/4 inch of the metal being heated. As the metal melts, the torch and the welding stick still forming the same angle are moved along, the operation being continued until the welding is completed.

Improving Welds

Where great strength is required the section of the metal at the weld may be enlarged. If it be desired to give the metal a closer grain, thereby toughening it, the weld may be hammered after being made and while still soft. Annealing is also very beneficial though it is not necessary in the general run of work. In the repairing of cracks, it is positively essential that the metal either be chipped, machined, or burned down to the bottom of the crack before commencing to weld. In this way only will a perfect weld be secured.

When in the course of a machining operation a defect is discovered which can be remedied by welding, it is advisable to weld at once without continuing to rough-finish the piece, so that if warping does occur, as is likely to be the case, no harm will be done. Hollow castings, of whatever metal, should be well packed with perfectly dry molding sand, not only to aid against warping but, when welding holes, to serve as a background for the metal being added.

Sheet Iron and Steel

Sheet iron may be welded even more satisfactorily than sheet steel and should be used in preference to it whenever possible. In sheet-metal work, the welds are practically all "butt" instead of "lap." When the thickness of metal is more than 3/16 inch, the abutting edges should be beveled either on one or both sides. It is sometimes even advisable to bevel sheets but 3/32 inch thick, as experience will, from time to time, demonstrate. If the shape of the piece does not permit of this being done by machine, which is usually the cheapest method, it must be done with the aid of the torch, otherwise the weld will be imperfect in that it is confined more or less to the surface and does not extend entirely through the metal.

FIG. 14. WELDED SHEET-METAL TANKS. SIZE 20X45 INCHES

It will very often be necessary to spread the two sheets apart at one end, holding them rather loosely in a clamp; otherwise, as the welding proceeds, the edges will tend to overlap. The sheets may also be placed with advantage, on a slight angle in such a way that the welding travels up hill, as it were, thus allowing the metal when melting to flow back against the flame, thereby making a slightly more uniform joint.

The sketches given in Fig. 12, which have been compiled from various sources, illustrate some of the many ways of making joints. The welding stick is usually of small Norway or Swedish iron wire; a good substitute for this is sheet iron (made from muck bar) when sheared into thin strips. Ordinarily no flux is required. Figs. 13 and 14 show a variety of welded sheet-metal tanks.

Wrought iron is as easily welded and the results obtained as satisfactory as with sheet iron, the same method being followed in detail.

Cast Iron

In the welding of cast iron, especially when the sections are thin, it is necessary to preheat the castings slowly to a dull red, to make the welds while in this condition, then to allow equally slow cooling. Only in this way will shrinkage strains be equalized or reduced and cracks avoided.

Preheating may also be resorted to as a means of minimizing the consumption of acetylene and oxygen, thereby lessening the cost. Figs. 15 and 16 show a torch and a furnace for two methods of preheating. In the one instance a generous flame, usually of coal gas and air, is directed upon the casting, heating it over a considerable area and especially in the vicinity of the weld. When the proper temperature has been reached the gas is temporarily shut off and the weld made, after which the heating flame is again directed upon the casting, being gradually reduced in amount.

In the second and more complete method of preheating, a temporary furnace of firebrick is built about the casting so that it is entirely inclosed. The casting is then heated to the proper temperature, the gas shut off, one or more bricks opposite the place to be welded are removed and the weld is made. The bricks are next replaced and the casting allowed to cool off gently. A welding stick rich in ferrosilicon is recommended; copper wire may likewise be used with excellent results. A good flux consists of red oxide of iron, Fe_2O_3, and borax, $Na_2B_4O_7 + H_2O$, in the proportion by weight of 15 to 25 parts of the former to 85 to 75 parts of the latter. Borax or common salt, NaCl, may even be used without the addition of any other substance, though the tendency of the latter is to harden the weld.

Some Other Metals

For malleable iron the same procedure as with cast iron should be followed throughout, but at best the welds will not be very satisfactory.

Cast steel is welded in practically the same manner as cast iron, except that the preheating is not absolutely necessary, though always helpful.

Brass is rather hard to weld owing to its low melting point. The metal generally requires to be supported to prevent its losing shape and the torch must be applied intermittently. Soft brass wire in preference to spelter, should be employed as a welding stick. It is necessary to use a flux to prevent volatilization of the zinc, borax answering the purpose admirably.

Aluminum

Aluminum is without doubt the most difficult of the more common metals to weld, due to the formation of a film of oxide over its surface which has until very recently resisted all efforts to remove it. Several authorities have lately outlined schemes of overcoming the difficulty, and

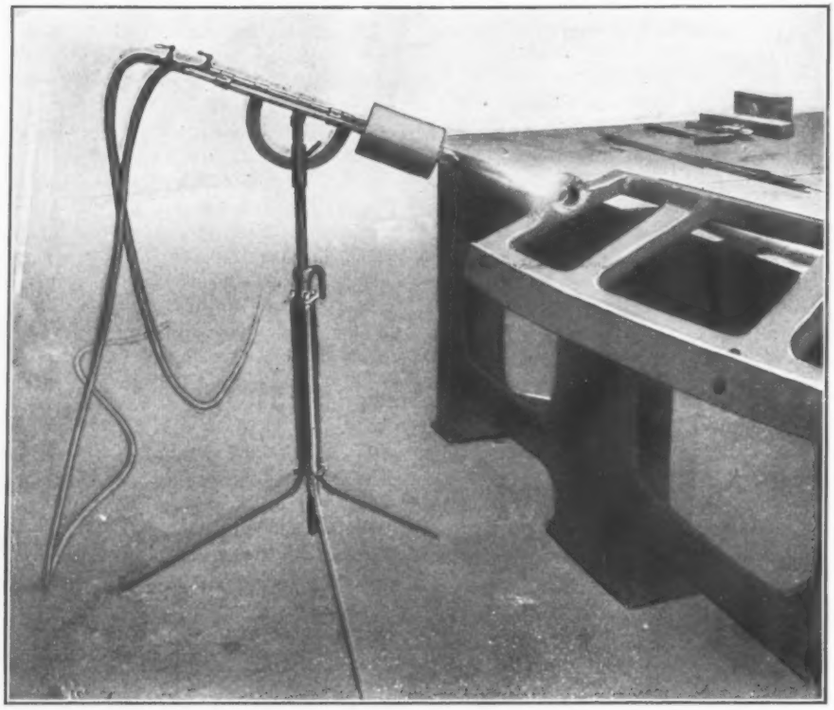


FIG. 15. PRE-HEATING TORCH IN OPERATION

the problem now seems in a fair way of being solved.

According to one method, the metal is quickly heated to a plastic condition in the vicinity of the proposed weld and is then puddled or worked with an aluminum rod in order to disintegrate the film of oxide.

In another method which, however, is more suited for the welding of rods by the Thomson (electric) process, the metal is quickly heated to a plastic condition and the parts are then suddenly shoved together, the object being the same as in the first method, namely, to break up the oxide.

Other authorities recommend the use of fluxes, these usually being composed of potassium chloride, KCl, or sodium chloride, NaCl, sometimes both, and lithium chloride, LiCl, or lithium fluoride, LiFl, in varying proportions, the mixture being melted and pulverized before being used.

Cutting of Metals

In addition to welding, the oxy-acetylene torch can be used for the cutting of steel or iron (not cast iron). Though not quite so economical as oxy-gas, the process can be substituted in many cases for machining, the work being done at reduced cost, in less time, with almost equal smoothness, with as little and sometimes less loss of material, and with no injury to the metal. Furthermore, irregular shapes, bevels, etc., which are entirely beyond the capabilities of standard machine tools, can readily be cut.

The torch differs somewhat from the one used for welding, in that it is provided with an additional nozzle for oxygen, as shown in Fig. 17. It is, however, manipulated in much the same way, the flame being directed upon the metal at the point where the cut is to begin, and thus continued until a bright red heat is obtained. The valve on the nozzle controlling the oxygen supply is then opened, allowing the jet to strike the heated spot when the metal at once commences to burn. The blast is sufficient to blow away the particles of the fused metal, leaving a clean narrow cut equal in width to the jet of oxygen, the pressure of which, as might be inferred, is considerably in excess of that used for welding, it being from 125 to 200 pounds.

Quality of Welds

The results of tests (Reich) on 3/64- to 5/8-inch open-hearth steel sheets, show that for equal sections, the metal at the weld after annealing, has an ultimate tensile strength of 80 per cent. and an elastic limit of 90 to 92 per cent. of that of the original material; the elongation varies considerably, ranging from 16 to 53 per cent. of the original stock.

Costs

It is difficult to give costs that would be of value for comparative purposes on anything other than sheet-iron or steel welding, and even the data on this class of work, as stated by different writers, vary within such wide limits, that the prospective purchaser of an oxy-acetylene plant is rather bewildered as to what welding really does cost.

In Fig. 18, curves have been compiled from the mean of data published by investigators both in America and in Europe and should, therefore, represent average conditions quite closely. The prices of labor and materials differ so much that it has been deemed best to plot the curves as shown, namely: In number of lineal feet welded per hour, number of cubic feet of oxygen at atmospheric pressure consumed per hour, and number of cubic feet of acetylene at atmospheric pressure consumed per hour, so that no matter what the range of prices may be, the total costs can still be figured with but little difficulty.

Taking, for example, labor at 30 cents per hour, oxygen at 3 cents per cubic foot, and acetylene at 0.94 cent per cubic foot (assuming calcium carbide to cost 4 cents

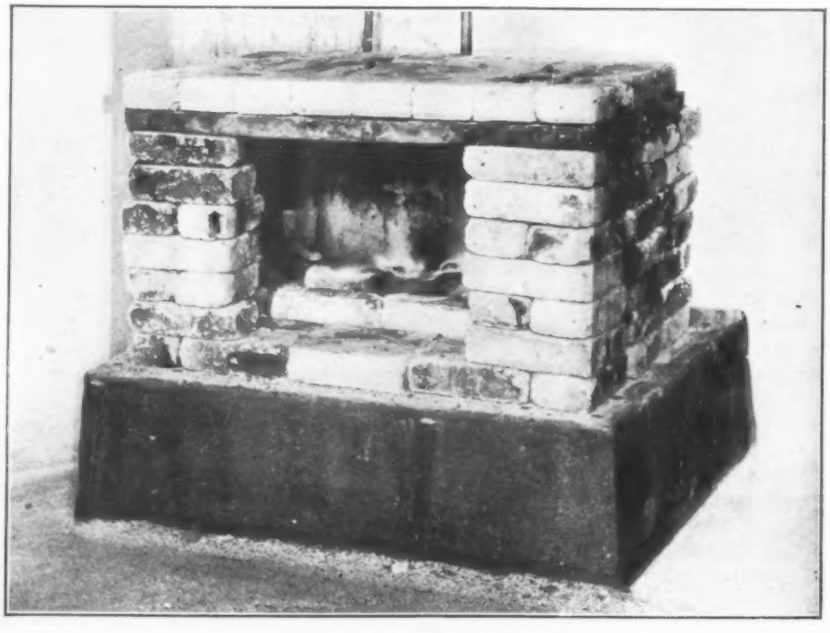


FIG. 16. PRE-HEATING FURNACE

per pound and to give 4.25 cubic feet of acetylene per pound), the cost of welding ⅛-inch sheet metal should be as follows:

Oxygen, 33.25 cubic feet per hour at.....	$0.03	=$0.997
Acetylene, 23.7 cubic feet per hour at.....	0.0094	= 0.223
Labor per hour at.....	0.30	= 0.300
Total labor and material..		1.520
Metal welded 7 feet. Total labor and material cost per lineal foot.....		=$0.217

Since a plant can be installed for a very small amount (from $200 upward), and

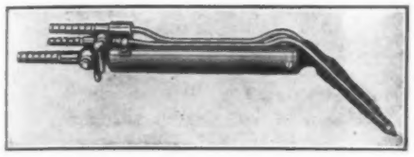


FIG. 17. CUTTING TORCH

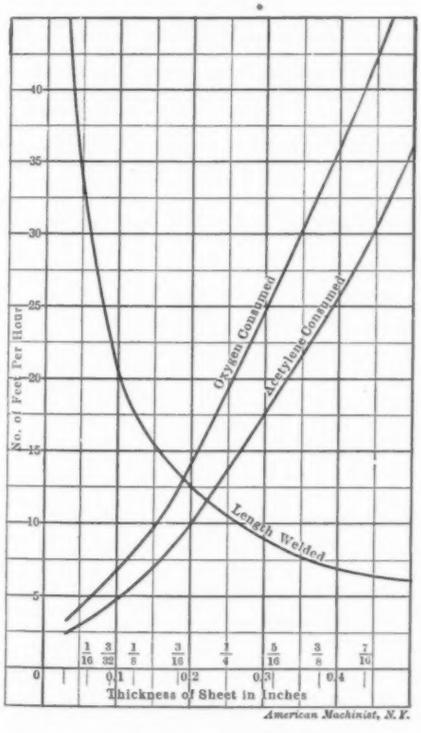


FIG. 18. RATE CURVE FOR DETERMINING WELDING COSTS, MEAN RATIO,

$$\frac{\text{consumption of oxygen}}{\text{consumption of acetylene}} = 14$$

since the cost of operation (labor) and maintenance are almost nil, the indirect expense, including interest on investment, is practically negligible.

Comparison of Methods of Welding

Attempts have been made by various writers to point out the superiority of oxy-acetylene over electric welding. Speaking broadly, the two are not comparable, each having its distinct field. The oxy-acetylene process, owing to the fineness of adjustment possible with the flame, is best adapted for welding sheet metals and for repairing small miscellaneous defects; the Thomson (electric) process requires that the metals to be welded be essentially of the same cross-section and resistance and hence is more particularly suited for uniting wires and rods, for making tires, putting heads on bolt and screw bodies, joining rails, etc.; the Bernados (electric) process has as its specialty the same general class of work as the oxy-acetylene process, but on a heavier and rougher scale where close regulation of the arc is not such an important consideration.

Wave Motors

By J. Richards

The Pacific coast is a prolific field for wave motors and has produced a large crop of these elusive machines. The name "Pacific" leads many to think the ocean is still; but this it is never. There are fewer great storms on the American side than occur on the Atlantic coast, but the meteorological and geographical conditions are such that the waves are ceaseless in their beat, upon the northern Pacific coast at least, and the circumstances suggest a waste of vast energy that should be applied to useful purposes, and a result is the contrivance of various kinds of conserving apparatus, usually without any logical or computed scheme or any permanent result.

The "vane" contrivances come around most often, predicated on the horizontal movement of a body of water which does not take place; but granting that it did, let us examine the result. Suppose a wave of the hight *a* in the diagram to be moving to the right with a force *F* of 1000 pounds and a resistance *R*, representing work equal to 500 pounds is opposed in the manner of the vane motors. No movement of this resistance can take place until the wave reaches the point *e*, and any more force above this point is lost. So is the part at *m* and if the vanes extend below the line *n* it will drag in half seas, and thus we can see all shaded portions of the diagram are lost—more than half the force. But this is not all. There is "time," or periodicity, to consider, which cuts out more than one-half of attenuated space *R*, reducing efficiency below one-fourth of the assumed force *F*, which really does not exist, because waves move forward only in a modified way.

The principal difficulty is that human ingenuity has not furnished any means of translating and using a *variable and intermittent force*. All kinds of useful work must be constant, and wave force is but a weak kind of energy.

The buoyancy class of wave motors are subject to similar infirmities; geared to any kind of resistance or work, no effect is produced until the resistance is overcome and the work begins, then all effect is, of course, useless and lost, and a diagram of the lifting force yields a narrow path, the same as with the vane motors depending on the horizontal component described.

It is a curious thing, when we come to consider it, that the whole field of achieved mechanism cannot transmit intermittent force variable in degree, and until such mechanism is provided the wave-motor inventor is but wasting his time, and usually someone else's money.

The most logical and successful one of the "tribe" drove a stiff pile in the mud, put around it an annular float that slid up and down on the pile which sustained the structure in storms, bored a hole in the top of the pile to receive a pump connected by a cross-bar and links to the float and thus sent some salt water ashore —a little salt water moved during the working range of the float, which was short, for the reasons explained. A patent was issued to the inventor, and should have been, because he made a contrivance that withstood rough weather and wasted only a small amount of money.

I cannot recall the name of the inventor but he came from Philadelphia and was prior to the lamented Mr. Keeley, of whom we all know too much. It is a thankless duty to advise the public in

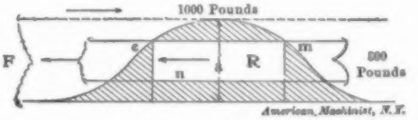


DIAGRAM OF WAVE ACTION AND AVAILABLE POWER

respect to such things; but there is one hopeful result; the honest consulting engineer is gaining in his status and more sought for by sanguine investors.

A case in point will illustrate.

An Englishman came recently to San Francisco by the Oriental route and on his sea journey met a wave-motor promoter of the usual type, with shares to sell in a wonderful machine then on exhibition. The Englishman was advised by friends to call on a consulting engineer of known standing and get his view of the scheme before purchasing stock. The interview was brief and laconic. The engineer said: "For an off-hand opinion on general grounds $10; for a written opinion of this device $100; for an analysis of wave power generally $300, take your choice."

He wisely took the $10 course and came back in a week to add his thanks and a further fee if wanted.

A statement compiled by the Bureau of Statistics shows that during the year which ended June 30 last, a year of declining exports in our trade as a whole, mineral oils showed a gain of over 100,000,000 gallons in sales to foreign countries, and a gain of nearly $2,000,000 in value.

Swapping Machine Tools

By R. E. Marks

Jones wanted a new grinder. He'd known for some time that he needed one badly to bring his product strictly up to date and get it out promptly, so he'd been studying grinders pretty carefully and settled on the Blank No. 3 as being just what he wanted. He'd told Jackson all the good points a dozen times, and how it had all the others left at the pole when it came to doing work along his line.

So you can imagine Jackson's surprise when he dropped in to Jones' shop the other day and found a Nameless instead of a Blank installed and at work.

"Why, how's this, Jones? I thought you had a Blank No. 3 machine all picked out for your work. Don't I remember its 57 varieties of improvements over any other, and here I find a Nameless. Were you hypnotized by the salesman, or what was the trouble?

"Hypnotized nothing. It's just on account of the pig-headedness of that man Blank. Told him he had the best machine for my purpose and I wanted one. He wanted a turret lathe, but he didn't want mine. Said it might be all right for drilling bread mixers, but he'd rather give me a grinder than have to use one of my lathes on his work. Wouldn't hear of swapping. Don't seem to know what reciprocity is. Now, I believe in the give-and-take plan. You use my lathes, I'll use your grinders. Can't expect me to use your machine when you won't use mine, can you, Jackson? Why, the world's business is built on reciprocity. I don't see how men like Blank get along, but he seems to."

"How's the other grinder doing, Jones? Turns out as much work as a Blank and of the same quality?"

"No, it doesn't, Jackson. That's what makes me sore at Blank. He knew I wanted his machine, that's probably why he was so stiff-necked about it. But I wouldn't use his machine anyhow after the way he talked about my turret. What are you laughing at anyhow?"

"At your short-sightedness, Jones, if you must know. If I had a disposition as touchy as yours I'd buy a glass case for it and keep it in the parlor.

"If you had heart disease and you knew Doctor Kurem's elixir was the best thing for it, would you hesitate between that and Doctor Guesso's pills because Doctor Kurem called you a fat lobster while the other fellow marveled at your beauty? Do you hire a toolmaker because he talks sweet to you and goes to your church, or because he can make tools?

"I'd do just as Blank did, though he might have used a little more tact in telling you your turret lathes were no good—for him. But if he believes they are not, he'd be several kinds of an idiot to put one in his shop just so you would get his grinder which you admit you ought to have anyhow.

"I wouldn't want one of my machines to go in a shop as an accommodation to *me*. Unless it makes good it's the worst kind of an advertisement you can have. You are letting yourself lose money every day just because Blank wouldn't swap for something he didn't want.

"Blank gets along because he buys the tools he believes are best for his work, whether the other fellow buys his or not. If he doesn't know enough to see that your lathe would save him money that's his loss. When you know his grinder would save you money and you get another make, that's throwing money away. If trade depended on that kind of reciprocity the balance would always be on the wrong side of the ledger."

There's probably more to this question than Jackson sees, or than appears on the surface. The question of barter as against cash or credit transactions has played its part in bringing this about and in imposing other hardships on those who do business either on a large or small scale.

But there can be no doubt as to the folly of swapping machine-tool or other products without due regard to getting the very best machine for our particular work. A poor or ill-adapted machine once installed is like an infected germ in a healthy body. Its influence is bad, it is hard to get rid of, and it is a constant hindrance in every way.

Firing Coke in Foundry Cupola with an Oil Burner

By R. H. Palmer

In some cities where there is a smoke ordinance the smoke caused by firing the coke in the foundry cupola with wood has been a cause of complaint, and to avoid it as much as possible, some foundries are using an oilburner, as the coke is easily fired with one, and the amount of smoke coming from the cupola in good weather is reduced to a light blue haze, when clean dry coke is used. If wet coke, or some wood is used, allowance must be made.

Owing to the location of the foundry of the Worcester Polytechnic Institute being among other buildings, the smoke from firing the coke in the cupola with wood became a nuisance, and other means were sought. Thus a Hauck oilburner was purchased and installed and the nuisance largely avoided.

In changing from firing the cupola with wood to the oilburner, no change in the cupola arrangement was made. The tank for the oil is placed on the charging floor between the two cupolas, and connected with the compressed-air supply. From this tank are two rubber hose for carrying compressed air and oil to the burner.

When the burner was first used, after the sand bottom had been put in the cupola, it was customary to place thin pieces of waste wood over the sand bottom, but this was found unnecessary. The coke is now placed on the sand bottom, and channelways formed leading from in front of the breast to the back of the cupola, by laying pieces of coke with the ends to the channelways, and leaving them a little apart so the flame will pass into these channelways and be drawn in among the coke, and upward by the natural draft of cupola.

On top of this coke about one-half of the bedcharge of coke is placed. The breast opening is left clear so the burner can be laid in the tap spout, and kept back from the opening some four inches. The pipes for air and oil are then connected and the valves in the burner pipes closed. After this the air is turned on to the burner air pipe and when the compressor gage shows thirty pounds the air is turned into the tank. The air valve to burner is then opened, and after this the oil valve until it is fired and the flame reduced to the size wished. The pressure gage by this time is showing twenty pounds with the air valve wide open, and this is maintained while the burner is in use.

I find a flame blue at the burner and running to purple, tipped with yellow, gives the quickest and best results.

The burner is kept on the coke for from 25 to 35 minutes, and is then removed, and the tap hole plugged. After this the rest of the bedcharge of coke is put in; the blast is put on for some twenty minutes, and the bed is burned up ready for charging.

It usually requires one gallon of kerosene oil to fire the coke to the point ready to put on the blast to complete the firing of the coke, but there are days when nearly five quarts are used.

To anyone who first gives the burner a trial, they will find it best to close some of the tuyere peepholes, and different arrangements of them may work better different days, but on the whole I have obtained the best results by leaving the peephole covers open at the front of the stack, and closing those at the back. Sometimes the coke will be found to be fired around the breast with little fire showing at the back, and at times the bed will be burned up in the center ready for charging and yet little fire will show at the back of the cupola at peepholes, but when the cupola has the iron charged into it, and receives the blast for melting the whole bed is found to be quickly on fire. I find there is usually about five minutes longer in the time of blowing before getting the iron for pouring.

Before giving the burner a trial I visited a foundry where they were using it to simply light the wood, instead of using shavings, and the end of the burner had been melted off by placing it in the breast

but by keeping the burner back from the breast opening this is avoided; although the end of the burner may get redhot, but not a melting heat.

In another foundry I am told they make very little preparation, simply leaving the breast open, thus forming a pocket in the front of the breast; place the burner in the tap spout and direct the flame into the cupola. They required a heavier pressure as they use crude oil, or fuel oil.

We find there is no special preparation of the sand bottom necessary, as the heat of the burner seems to fuse the top of the sand bottom into a crust. I have had some experience with using compressed air and illuminating gas to fire the coke, but find the oilburner much cheaper.

A Convenient Filing Cabinet for Clippings from Technical Journals

By W. S. Gieb

While the value, to the engineer, of regular reading of the journals devoted to his field can hardly be questioned, no man can hope to retain all he reads. The recollection of having somewhere, some time seen just the information he may want at the moment, is hardly to be considered an asset.

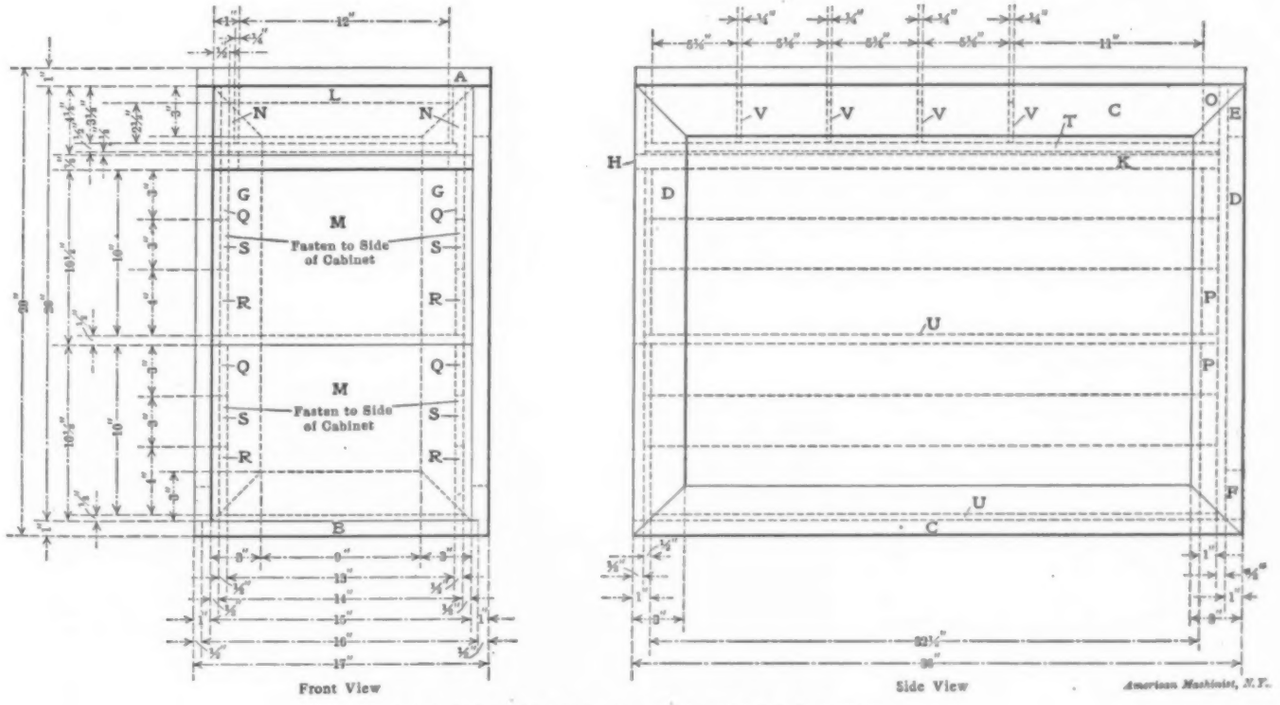
To be of real value the information contained in the technical journal must not only be located but immediately accessible when it is needed. Clipping seems to be the accepted mode of separating the articles desired for classification and there seems to be nothing which excels the vertical system of filing for classification and accessibility nor for maximum of capacity with reference to space occupied.

The cabinet shown herewith was designed to combine the advantages of the vertical system with those of portability. One built as here shown has been in use by me for six years, forming one leg of a desk. A cabinet of similar exterior dimensions but with drawers arranged as in an ordinary desk forms the other leg and a 36x72-inch drawing board forms the top. The second cabinet is, of course, not necessary to the scheme and may be replaced by a plain leg or whatever else may be convenient.

The construction is as simple as possible to keep down the cost and at the same time heavy enough to stand shipment with its contents without crating, as has been demonstrated several times by actual experiment.

The two lower drawers are for clippings from standard size 9x12-inch trade journals. Divided folders for two 6x9-inch clippings can be easily constructed if desired. The top drawer provides four compartments for 3x5-inch index cards and a compartment at the rear 11x12 inches for folders, cards, clippings to be filed, etc.

The material of the cabinet may be as desired. White pine is easy to work and makes a strong light cabinet. The list is as follows: 1 top *A*, 1x36 wide x 17 inches long; 1 bottom *B*, 1x36 wide x 16 inches long; 4 top and bottom side battens *C*, 1x3 wide x 36 inches long; unite the ends and cut shoulder in two, 1 inch from edge x½ inch deep; 4 end side battens *D*, 1x3 wide x 27 inches long, miter ends; 1 top rear batten *E*, 1x3 wide x 15 inches long, miter ends; 1 bottom rear batten *F*, 1x3 wide x 15 inches long, miter ends; 2 side rear battens *G*, 1x3 wide x 26 inches long, miter ends; 1 cross bar *H*, ⅞x3 wide x 15 inches long; 2 top drawer slides *K*, ⅞x1 wide x 31½ inches long; 1 top drawer front *L*, 1x4⅛ wide x 15 inches long, cut the shoulders 1½ inches from the end x ½ inch deep and ⅝ inch from lower edge by ½ inch deep; 2 large drawer fronts *M*, 1x10½ wide x 15 inches long, cut the shoulders 1 inch from ends x ½ inch deep and ½ inch from the lower edge by ½ inch deep; 2 top drawer sides *N*, 1x4⅛ wide x 34 inches long, cut the shoulder ⅝ inch from the bottom edge by ½ inch deep and cut 4 notches in each ¼ inch wide x ¼ inch deep on the same side as the shoulder, the first notch 5⅝ inches from the front end, the distance between notches 5⅛ inches (= 5⅜ inches centers); 1 top drawer, rear end *O*, 1x3½ wide x 12 inches long; 2 large drawer rear ends *P*, 1x10 wide x 13 inches long; 4 large drawer upper sides *Q*, ½x3 wide x 34 inches long; 4 large drawer lower sides *R*, ½x4 wide x 34 inches long; 4 large drawer slides *S*, ½x3 wide x 34 inches long; 1 top drawer bottom *T* ½x13 wide x 34 inches long; 2 large drawer bottoms *U*, ½x14 wide x 34 inches long; 4 top drawer partitions *V*, ¼x2½ wide x 12½ inches long; 3 drawer locks not shown; 3 drawer pulls not shown; 4 casters not shown.



A FILING CABINET FOR CLIPPINGS FROM TECHNICAL PAPERS

More Machine Tools Designed by Leonardo

Automatic Machines for Gold Beating, Needle Grinding, File Cutting; Grinding Parabolic Mirrors and Hollow Cylinders; Sprocket Chains

BY EDWARD P. BUFFET

We shall continue our examination of the machinery and tools contrived by Leonardo da Vinci, 400 years ago, basing our discussion on the sources of information heretofore mentioned, with particular credit to Prof. Th. Beck's publications in the *Zeitschrift des Vereines deutscher Ingenieure* and elsewhere.

Power Hammers

One of the most remarkable instances of Leonardo's automatic machinery is a gold-beating hammer, which contains a self feed for the material and other refined features. It is depicted in Fig. 51 (CA8). The bar of gold rests on an anvil above which is suspended a stamp, actuated by a trip or cam movement at the top. This hammer travels with the cam shaft from right to left by a wheeled carriage, which runs along the top of the frame. The bearings on the carriage through which the shaft passes are absent from the drawing. In the bearings which connect it to the fixed frame it is allowed an endwise play to permit the aforesaid travel, which is facilitated by one or more anti-friction rollers, on which it rests. The leftward movement is produced by an interrupted worm, or rather worm segment, around the cam shaft, which is one of an interchangeable series with different pitches. They permit a number of hammer blows varying from four to eight per revolution of the shaft, according to the breadth of the gold bar, which increases as it is flattened. A drawing not here reproduced shows these worm segments attached to the shaft at the same time, which would be quite a feasible arrangement if the substitution were effected by shifting the position of the leader. A note of Leonardo's, however, suggests that each of them is singly attached in the same position by screws every time it is desired to use it. This appears to be a very time-wasteful method if several changes have to be made in the flattening of one bar. No doubt a variety of experimental methods was tried by da Vinci in this, as in other details.

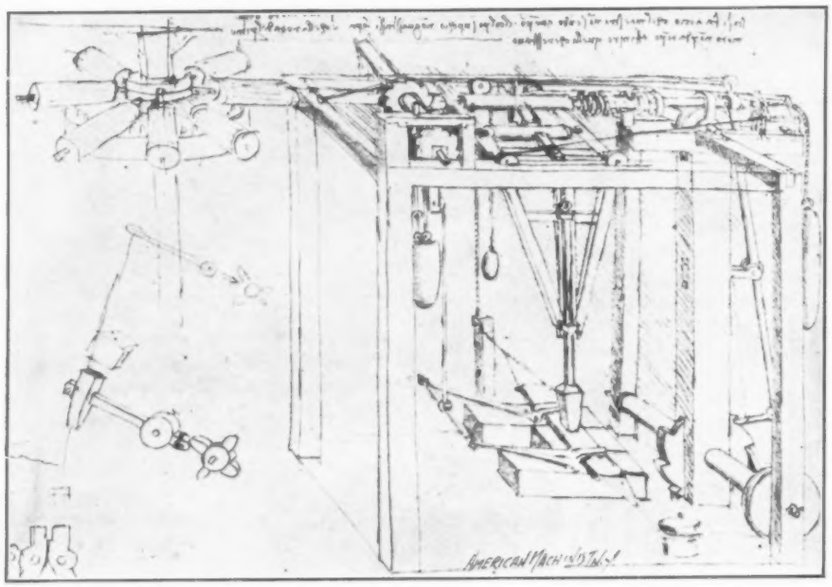


FIG. 51. ADJUSTABLE AUTOMATIC POWER DROP HAMMER FOR GOLD BEATING

When the carriage, with cam shaft and hammer, reaches the end of its course, that is to say when the worm lets go, it is quickly returned to the right side by a counter weight, to begin over again. At the same time the ingot is given an endwise movement by the coöperation of mechanical trains at both sides of the machine. The mechanism at the left hand controls the grippers which hold the bar in place on the anvil. At the proper moment, by means of a ratchet and counter-weight mechanism the grippers are released, leaving the work free for the operation of the draw feed at the right hand. This also comprises a ratchet, lever and drop weight, which, by means of a cord passing over a drum, pulls the bar along for a hammer's breadth on the anvil.

It will have been noticed that the driving work suggested a symmetrical group of eight hammers impowered from the same vertical shaft, as occasion required, if not simultaneously. A horizontal plan of such a group containing six hammers appears in Fig. 52 (CA21). These happen to be helve hammers, and the quick return of their horizontal travel is produced by springs instead of weights. The same

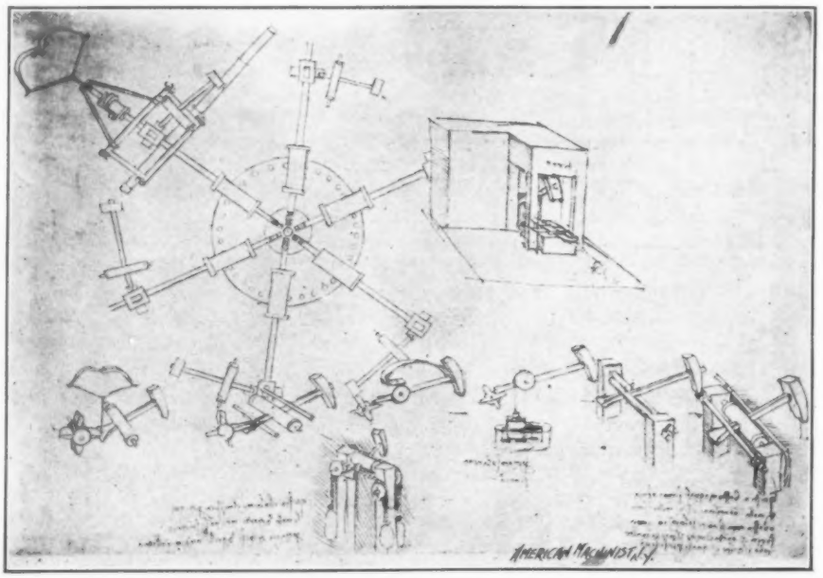


FIG. 52. HORIZONTAL PLAN OF SIX GOLD-BEATING HAMMERS AND STUDIES IN HAMMER MECHANISM

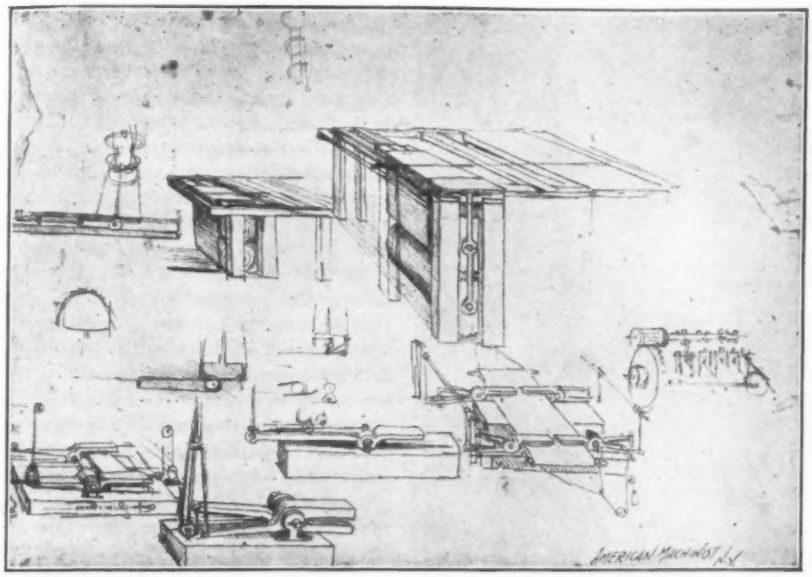


FIG. 53. INGOT GRIPPERS, AUTOMATICALLY CONTROLLED, AND OTHER MECHANICAL DESIGNS

plate shows a number of hammer detail studies, which are worth scrutiny, but will not here be explained in full. The third from the right, at the bottom, is a hammer actuated by a cam in striking and raised by a weight, which drops into a dashpot of sand under water.

Fig. 53 (CA380) illustrates a number of grippers resembling those used in the gold-beating process; wherefore we might assume that the machine in the upper part of the plate is intended for rolling gold. Comparison with other drawings, however, goes to show that it is the table of a cloth-shearing machine, and this implies, although not conclusively, that all of the devices on the plate are intended for textile purposes.

A peculiar hard-hitting trip hammer is

FIG. 58. ANOTHER NEEDLE HOLDER (?) WITH GEAR TRAIN

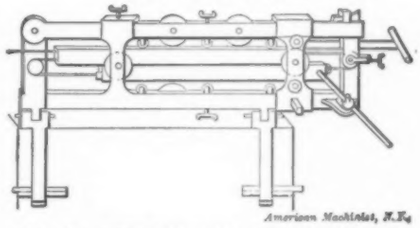


FIG. 59. RECIPROCATING TYPE OF NEEDLE HOLDER

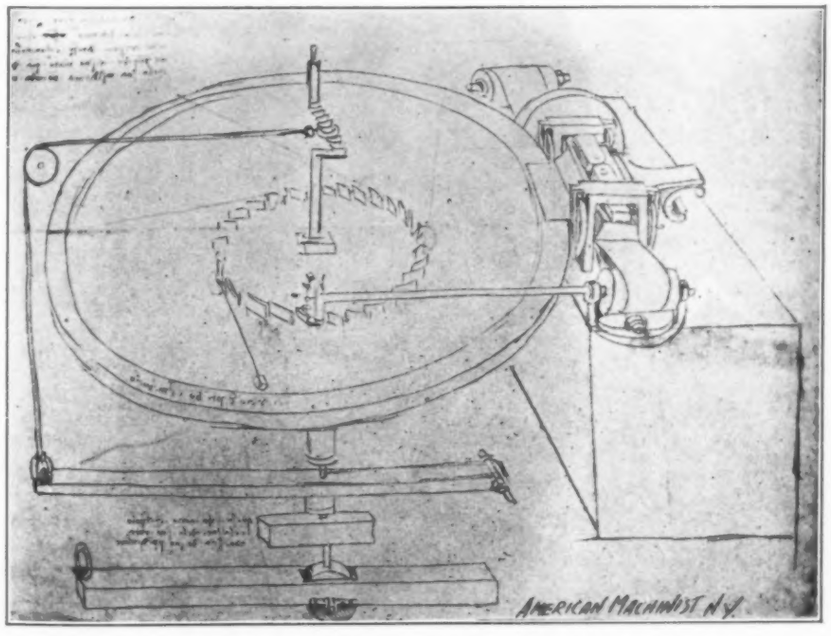


FIG. 55. AUTOMATIC NEEDLE-GRINDING MACHINE

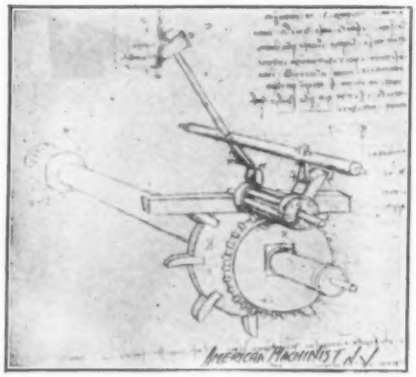


FIG. 54. HARD-HITTING TRIP HAMMER WITH DOUBLE CAM MOVEMENT

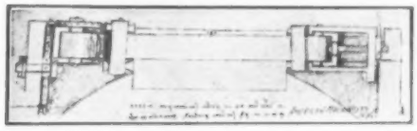


FIG. 57. NEEDLE HOLDER WITH BELT TIGHTENER

drawn in Fig. 54 (CA11). To understand its action we must bear in mind that the stroke is made from left to right. The hammer is raised by one of eight cams on the main shaft and carried beyond a vertical position, so that it drops back against a wooden support faced with a spring, in which position it is shown. The spring aids the return movement, which, however, is chiefly caused by a reversely turning cam on a shaft geared high from the speed of the main shaft, and by this it is hurled down upon the anvil.

Gang Automatic Needle Grinding Machine

A class of intricate machines, designs

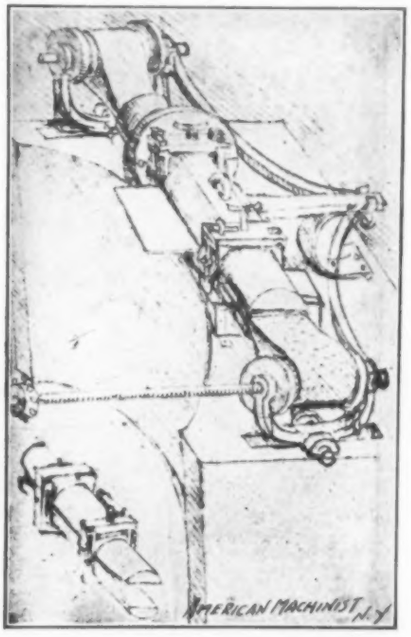


FIG. 56. MOVING BELT MECHANISM FOR HOLDING AND ROLLING NEEDLES

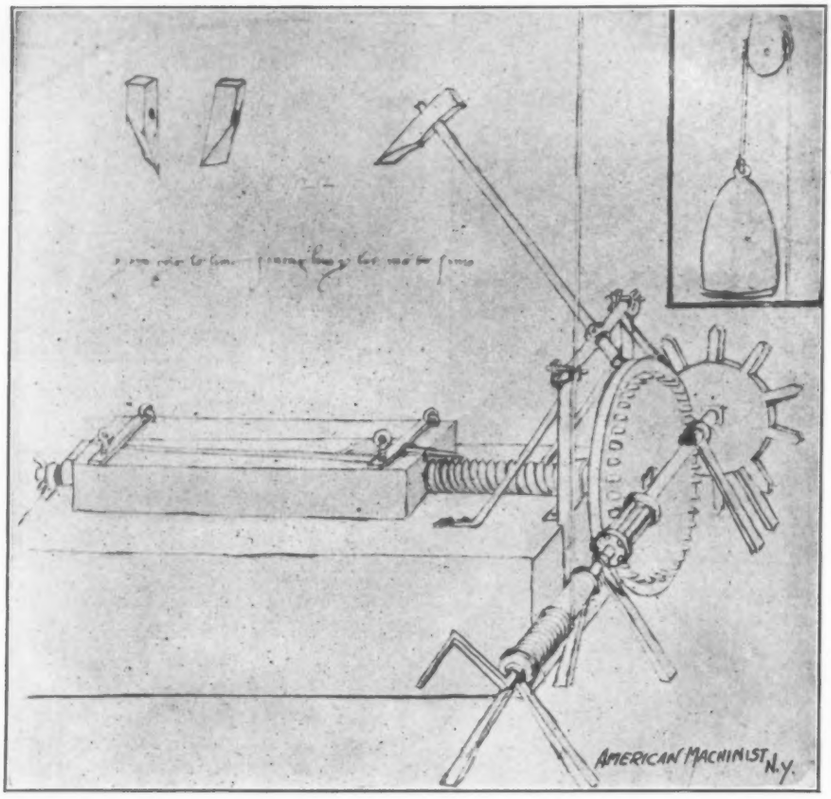
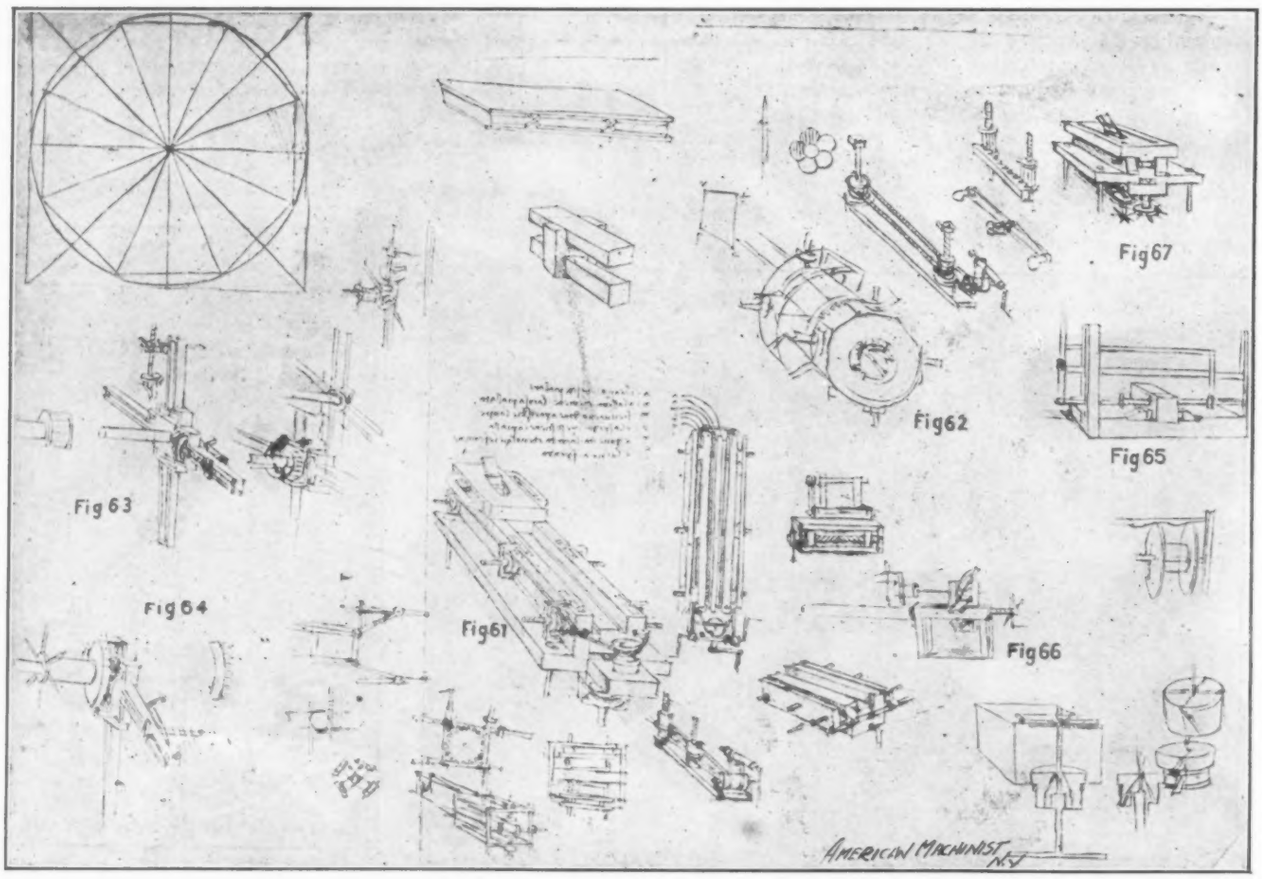


FIG. 60. FILE-CUTTING MACHINE WITH AUTOMATIC SCREW FEED

for which are dispersed through Leonardo's manuscripts, has been identified and explained by Professor Beck with admirable insight. The best example of these designs is that presented in Fig. 55 (CA31). The large horizontal wheel is an abrasive one, its rim being of lead with emery applied. To form the needle point the wheel is raised or lowered by a lever, on which it is supported, and in order that the shaft may remain vertical during this change in elevation, it is provided with a peculiar step bearing; it rests upon a vertical roller shown in a detailed view at the bottom, which view is not clearly separated from the main drawing. The elevation of the spindle is produced by a cord passing over pulleys and ending in a ring engaged in a helical groove on a jib-shaped crank, so that as the crank turns the ring moves upward or downward in the helix, thus being relaxed or tightened, and lowering or raising the step of the spindle. On the abrasive wheel is a small crown of spiral teeth, very unusual, although simple, in design, which mesh with a spur gear the spindle of which actuates the needle-holding mechanism at the right hand.

The aforesaid holder consists essentially of an endless belt passing over rolls and rolling the needles between its upper and lower parts, which are held together by



FIGS. 61-67. PLANING FIXTURES, CENTERING OR CHUCKING DEVICES, SAW, BORING MILLS, ETC.

appropriate blocks. The needles are pressed against the grinding wheel by a spring. Fig. 56 (CA57) is an enlarged perspective view of such a needle holder, and Fig. 57 (CA318) is a horizontal plan of another, showing variations in design, partly in the adjustment of belt tension. Fig. 58 (CA374) is still another device, seemingly designed for the same object, a gear train being here interposed for driving.

Referring again to Fig. 55, it is apparent that one grinding wheel was intended to act for the service of six needle holders, distributed around its periphery, as indicated by the little circles and tangents to the crown gear, which denote the position of the connecting spur gear and shaft.

The continuous belt type of needle holder seems to be a final form perfected after essays with reciprocating motion. A drawing illustrative of these tentative models is reproduced in Fig. 59 (CA25).

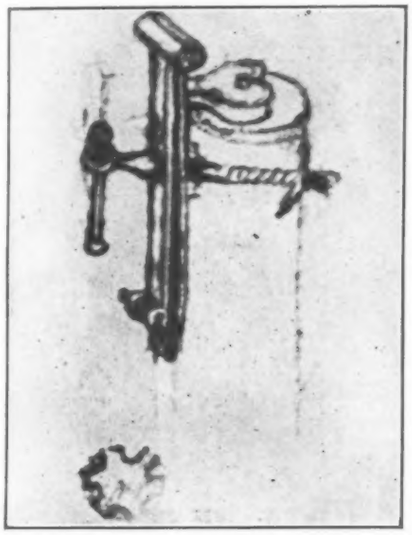


FIG. 68. VISE

File-cutting Machine

After what has preceded, it need hardly astound us that Leonardo conceived the cutting of files by machinery. His design for the purpose is presented in Fig. 60 (CA6). The file blank, whose shape has undergone little change in the last four hundred years, is clamped on a block and fed from tooth to tooth by a screw feed. The star wheel at the further end of the crank shaft is intended as the cam wheel to trip the hammer. The machine is not operated by turning the crank, but by the drop weight with a cord passing over a drum on the shaft, the apparatus being wound up with the crank before starting. On the plate are shown two detached chisel heads with differently beveled edges, apparently intended for double cutting of files.

Planing Machines, Etc.

The plate reproduced in Figs. 61-67 (CA38) contains several interesting machines, chief among which is a wood-planing machine, or rather planing jig, Fig. 61. The plane is moved by hand in guides, while the mechanical feature seems to be a simultaneous chucking of the work at six points by means of a cord passing over rollers which are nuts on six clamp screws. The chucking or centering idea is prominent in other sketches on the plate. For instance, in Fig. 62 we perceive a detail of the boring machine already described in Fig. 21. Figs. 63 and 64 indicate a cruciform contrivance for centering or chucking purposes and neighboring sketches possess an analo-

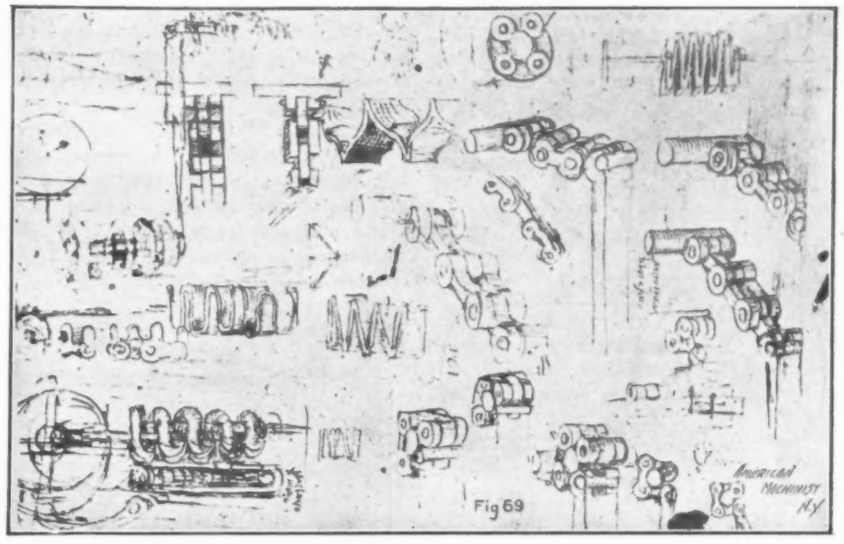
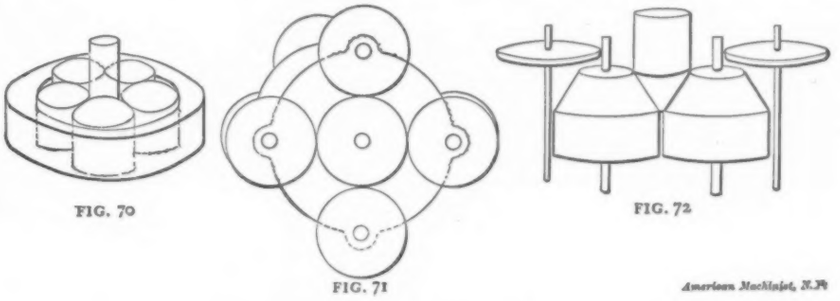
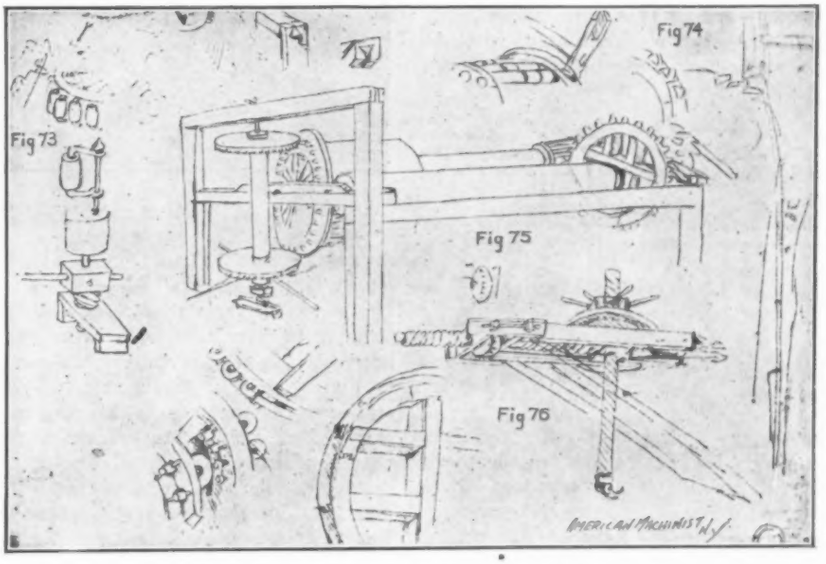


FIG. 69. SPROCKET CHAINS FROM LATEST PATTERNS, CHAIN WRENCHES, SPRINGS, ETC.



FIGS. 70-72. ROLLER BEARINGS AND FRICTION-CONE GEARING



FIGS. 73-76. ROLLER-TOOTHED GEARING, ROLLING MILL(?) AND SCREW CRANE

gous character. Further in the illustration may be observed a saw, Fig. 65, while Fig. 66 is the bow-spring boring machine that has been more clearly illustrated in Fig. 22. Fig. 67 is another planing jig differing from the one in Fig. 61.

Fig. 68 (H107) shows an iron vise

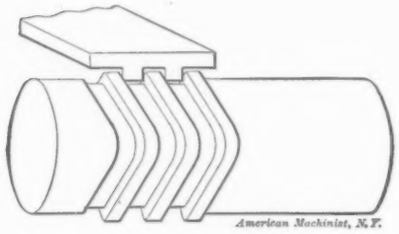


FIG. 77. DRUM CAM

screwed on a post. In form it looks a little old fashioned, yet is not very unlike the vises of today, for the vises of mankind are pretty much the same from age to age.

MECHANICAL DETAILS—CHAINS

One of the most interesting plates in all Leonardo's manuscripts is that reproduced in Fig. 69 (CA357). It deserves very careful examination. In it we find the typical modern form of sprocket chain, of lenticular and other patterns. I wonder whether there is not enough here to invalidate the patents on some of our leading anti-friction transmission chains. In addition to chains the plate shows zigzag devices which appear to be compression springs. But further, it is very apparent that some of the chains are applied for twisting bars after the fashion of the present-day chain pipe wrench.

ANTI-FRICTION BEARINGS

Several anti-friction bearings, of roller, cone and similar types are selected for reproduction in Fig. 70 (CA364), Fig. 71 (CA365) and 72 (CA390).

An interesting plate is Figs. 73-76 (CA391), which, among other things, shows

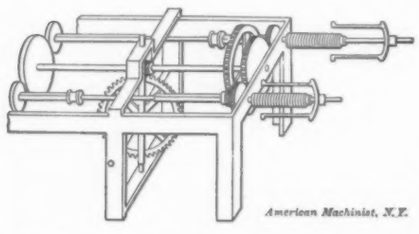


FIG. 78. SPINNING MACHINE, ILLUSTRATIVE OF GEARING

in Fig. 73 a design of roller teeth for gearing. In Fig. 74 are two peculiarly shaped axes or cutting hammers, which from their proximity to special gear teeth, would seem to be intended for forming the same. Fig. 75 looks like a rolling mill of some kind, while Fig. 76 is considered by Professor Beck to be a sort of traveling crane. Horizontal and vertical motions are obviously obtained by screws, at the lower end of the vertical screw being a hook.

GEARING AND CAMS

Adequately to present and describe the sketches of gearing and cam movements alone that are found scattered through Leonardo's manuscript might fill an entire number of the AMERICAN MACHINIST. Every conceivable variety of gearing, known and unknown, appears to have entered Leonardo's head and to be preserved in his sketches. Hindley worms are one of his types which are generally believed to have originated at a much later date. A good drum cam is depicted in Fig. 77 (CA347). Fig. 78 (CA377) represents details from a spinning machine which are here reproduced as fine examples of gearing. A machine of undiscovered purpose, which contains a great deal of rack gearing, is shown in Fig. 79 (CA321). I think it possible that this apparatus may be intended for a draw bench. A high power could be obtain by pulling the rack that rests on top of the gear wheels.

Another vast field of ingenuity worked by Leonardo was that of hoisting machinery. His drawings show startling anticipation of many modern types of cranes. The number of such sketches discourages me from the attempt to reproduce them. However, I select one or two for the purpose.

A GEARED TONGS

In Fig. 80 (CA379) is shown the moving mechanism of a pair of tongs, brought together by a combined screw, gear, rack, and crank-power device, which must produce a very high pressure. We must conceive of the large gear wheel in the fork as keyed to the screw, with right and left threads on either side, so that as the gear turns it brings the shanks of the tongs together. The rack may be long so that the tongs can be used for gripping distant objects. A suggestion of thumb-clamping nuts beyond the main nut on the screw outside of the shank is a little difficult to understand.

Another pair of highly powered tongs,

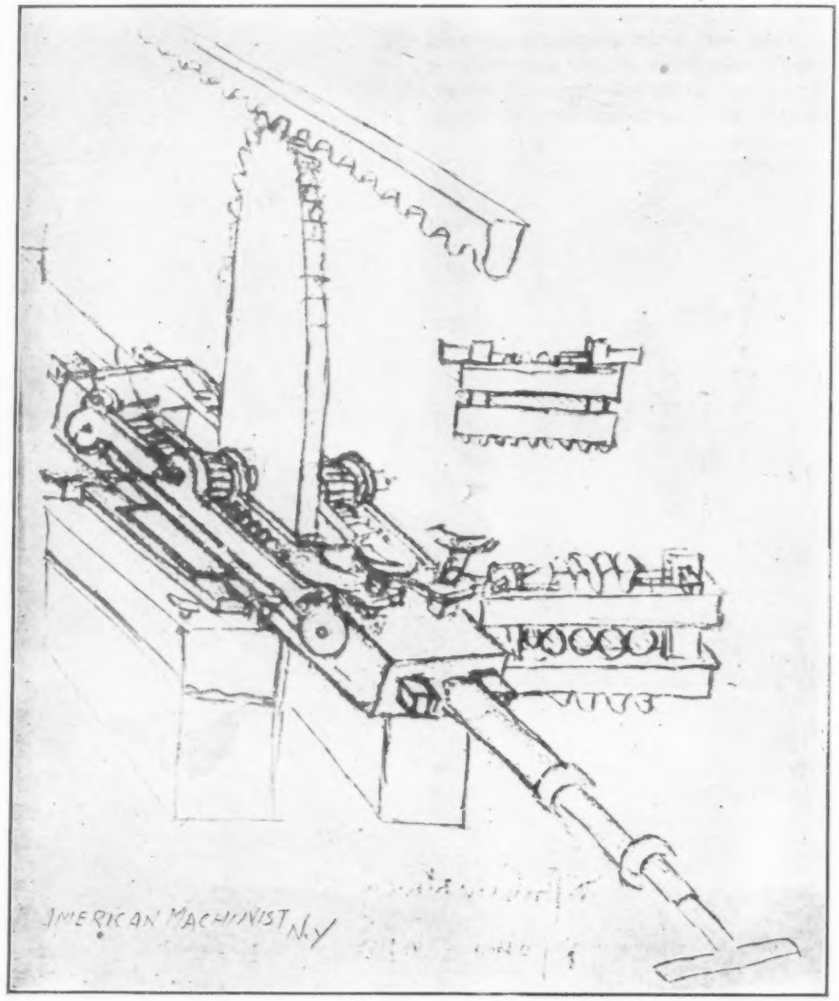
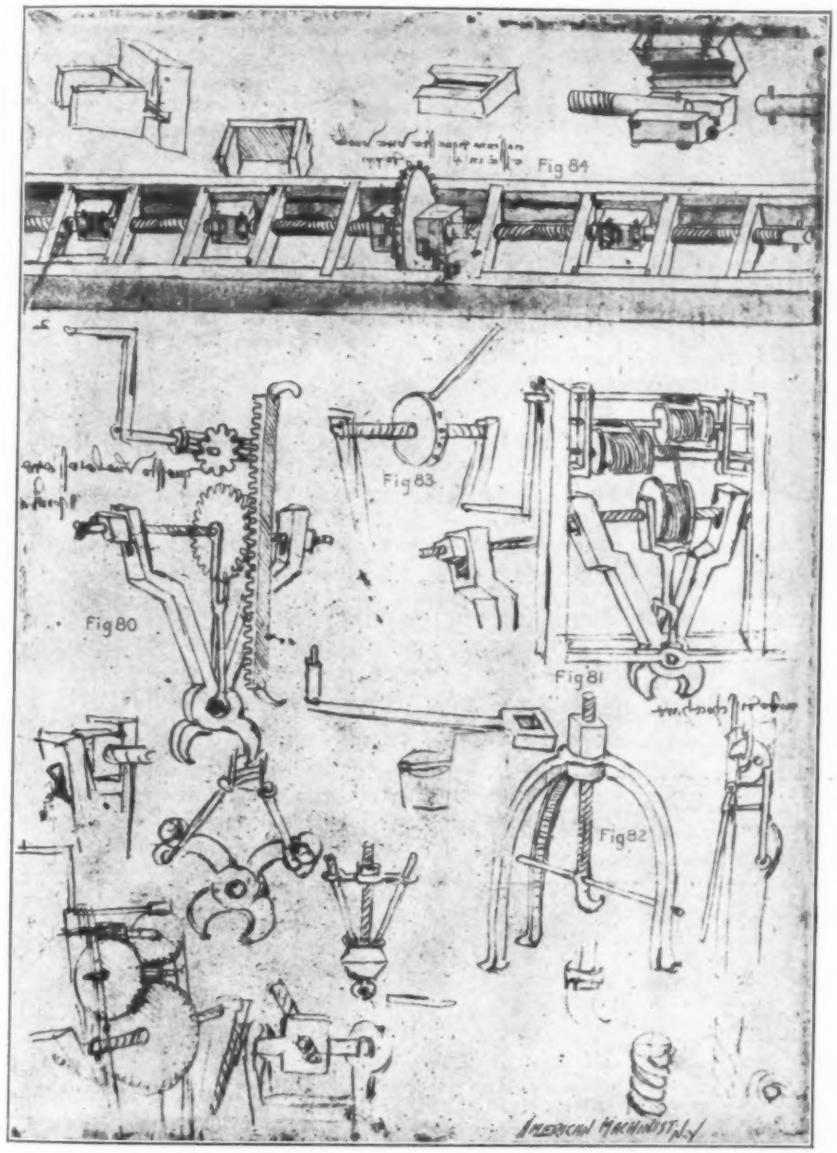


FIG. 79. CURIOUS MACHINE WITH MUCH RACK GEARING

geared in part by cords and pulleys, stands forth in Fig. 81. A jack evident in Fig. 82 and in Fig. 83 a capstan disk or wheel.

Some Transmission Details

Fig. 84 (CA379) shows a mechanism for exerting endwise pressure by means of right and left threaded screws, which are joined together by clamp couplings illustrated in detail. These couplings are a feature of interest in the appliance.



FIGS. 80-84. HIGHLY GEARED TONGS, LIFTING JACK, LONG SCREW CRAMP WITH CLAMP COUPLINGS

Fig. 85 (CA365) is presented as an interesting detail showing the method of attachment of a band. We shall not consider its purpose.

Making and Grinding Concave Mirrors

The concave mirrors by which Archimedes is reputed to have set on fire the ships in the harbor of Syracuse, were presumably the source of inspiration for Leonardo to execute or project a most ambitious series of operations along the same line. He left a great deal of matter relating to it, which is found more particularly in manuscript G of the French Institute collection.

The importance attached to this work by Leonardo himself is evident from the secrecy with which he enwrapped it, fearful even of a comprehensible description in his own private documents. Not content with his ordinary right-to-left-hand writing, he took the pains to obscure certain words, particularly those specifying the materials of construction, by a further reversal of the letters, and also by the use of symbolical names for them. The different metals were designated by names of planets according to alchemistic terminology with some additions that seem to have been original with him. Thus the sun meant gold, the moon silver, Mercury quicksilver, Venus copper, Mars iron, Jupiter tin, Saturn lead and Neptune apparently bronze. Whether to conceal his idea or otherwise, he employed certain words in unusual senses, which have to be inferred from the context. Thus the Latin word *ignia*, meaning "fiery" or "burning" things, denoted his mirrors. A favorite term was *saghoma*, a Lombard word, which commonly means "form," but which he employed with special significance, denoting by it a class of templets, grinding machines and appliances for forming and polishing curved surfaces. Correspondingly the participle *saghomata* indicated that work on which the operations of the *saghoma* were performed. Furthermore, Leonardo studied mathematically and geometrically

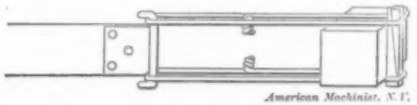


FIG. 85. METHOD OF ATTACHING A BAND

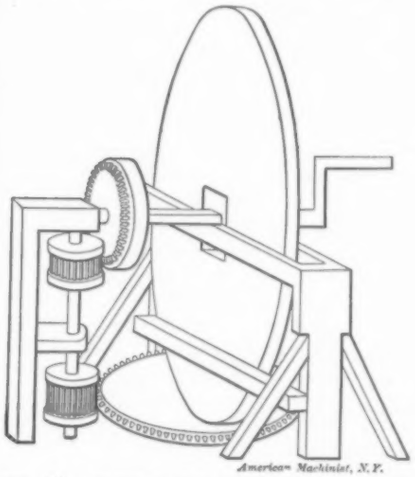


FIG. 86. GRINDER FOR CONCAVE REFLECTORS

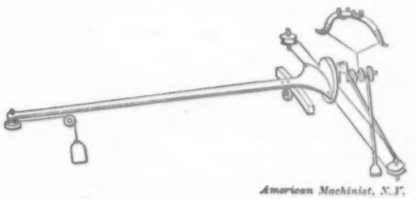


FIG. 87. LONG-RADIUS GRINDER FOR REFLECTORS

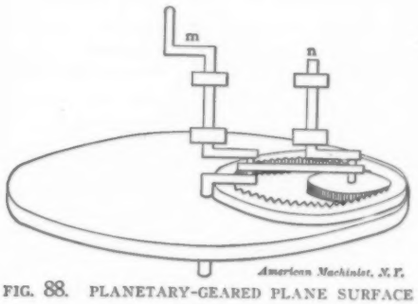


FIG. 88. PLANETARY-GEARED PLANE SURFACE GRINDER

what he called the pyramid, by which he meant a cone of light rays.

It is highly to the credit of Professor Beck that in his "Beiträge," he has succeeded in unsnarling this tangle of mechanical and scientific ideas. The construction of Leonardo's large mirrors was pioneer work from the bottom up. His method essentially consisted in plating a convex marble form with copper bands, soldering them together and, after removal from the form, subjecting them to a suitable amalgamation and polishing on the concave side. He invented machines not only to grind the convex and concave surfaces, but to draw out the copper bands.

It would be of the greatest interest could we turn aside to follow the processes from start to finish and study the alternative types of machinery, which he designed for the different kinds of work. He made not only built-up copper mirrors but, it would appear, smaller mirrors of glass and metal. His sketches show machines for grinding with both long and short radii, whether of forms, mirrors or grinding tools.

An elementary type of these grinders is found with several variations in Leonardo's sketches, the work being arranged as a vertical wheel whose surface turns against a horizontal abrasive templet. This could hardly have been used other than for roughing purposes. A more refined mechanism is seen in Fig. 86 (CA32) where the vertical wheel is the grinding one and the horizontal gear carries a mirror of clay overload with glass to be concaved. It is evident that the surface thus figured will become approximately parabolic, since the outer part is less constantly exposed to abrasive action than the center. On the same sheet Leonardo discusses the parabola as the proper section for reflectors.

A grinder for concave surfaces with long radii appears in Fig. 87 (CA396). The mirror is fixed upon the wheel turned by the foot-power drive at the right hand, connected with which is a cord passing over pulleys so as to give an oscillating motion. The slightly curved grinding templet turns about its center at the left and is maintained in constant pressure by a weight.

Grinding of spherical surfaces, however, is a mere bagetelle as compared with grinding flat ones. More worthy, therefore, of our attention is the plane-surface grinder illustrated in Fig. 88 (CA396). The mechanism embodies three revolving motions. The large grinding wheel is turned by a crank in the center, which is connected with a small planetary gear carrying the work to be ground, and this runs in an internally cut gear. It is, therefore, evident that the planetary gear will rotate about its axis, revolve about the axis of the large disk and at the same time execute a motion to and from the center of the latter.

Multiple Wet Grinder

Fig. 89 (CA7) illustrates a grinding and polishing machine with more than one abrasive wheel. Leonardo's written instruction relates to wheels of different kinds of wood, covered with leather or uncovered, and supplied with tallow and emery, or oil and emery. Some of the detailed drawings not reproduced show how these wheels are built up. Apparently the grinder is provided with a flow

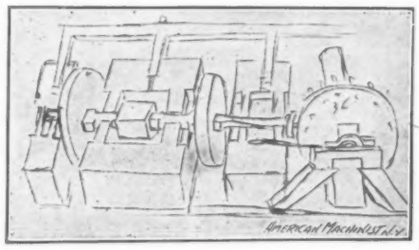


FIG. 89. GANG GRINDING AND POLISHING MACHINE

of water. The spindle is evidently joined together with muff coupling.

Emery Machines for Sanding Insides of Hollow Cylinders

An exceedingly ingenious machine, which in the modern nomenclature of woodworking might be termed a "sander," is illustrated in Figs. 90 and 91 (CA291). It is intended for smoothing out the interior of a wooden hollow cylinder with emery and oil by means of another cylinder which enters it with a reciprocating

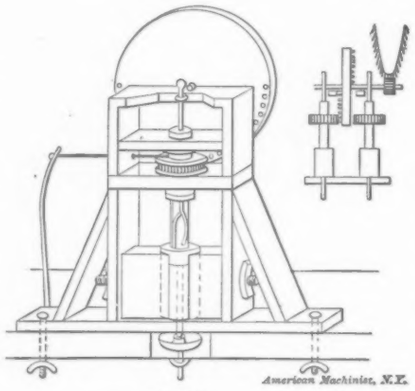


FIG. 90 FIG. 91

EMERY SANDER FOR INSIDES OF HOLLOW CYLINDERS

helical motion, and which we may designate as the plunger. The hollow cylinder is chucked vertically at the bottom of the machine. The plunger cylinder, provided with circular grooves for the oil and emery (which grooves have a forked aspect in the cut) is mounted on a square spindle with screw shank, so that when turned it will not only revolve the plunger, but advance or withdraw it. On the shank of the spindle is also a gear meshing with a crown wheel toothed around half the face only, so that after having rotated and advanced the plunger a certain distance, the blank portion is reached and it lets go for half a revolution. As it disengages, the plunger is brought back to its initial position by the gear, which is reversely turned by a drum, cord and spring. While the gear is in mesh, this spring is compressed. A pan below catches the emery as it falls through. It was Leonardo's intention that machines of this type should be used in pairs, one driving gear half-crowned on both sides, in alternate semi-circles, answering for both. Fig. 91 shows how this was to be done.

Were Leonardo's Machines Actually Constructed?

Very properly may arise the query whether the machines designed by Leonardo were actually constructed. While no positive answer can be given to this question, there is strong presumptive and circumstantial evidence that many, if not all of them were really built. It was Leonardo's avowed principle that theory and practice should go hand in hand and that hypotheses should be verified by experiment. His sketches and notes bristle with indicia that he carried out this principle in his engineering activities. I think that any machinist will readily dismiss the possibility of designing such vast groups of mechanism, so practical in character and form as Leonardo's, merely by way of air castles and without the constant assistance of experimental proof. Fantastic conceptions are few in Leonardo's designs and the working element is everywhere paramount. Constructive details with which the drawings are filled would never have been reached by an unaided imagination.

But overwhelming is the inference to be drawn from his annotations upon the plates. These are evidently intended as memoranda for his private use and not as clear, comprehensive descriptions for others' information. He therefore omits to state the general purpose of a machine, which he is in no danger of forgetting, but jots down incidental notes on materials employed and minor features of construction, which he cannot be sure of remembering. These notes often embody practical hints, suggestions for overcoming difficulties and warnings against mistakes to be avoided, which must be the result of experience and can have emanated only from the shop.

The official report of the United States Commissioner of Navigation for the fiscal year ending June 30, states that new contracts recently let indicate a material increase in activity in the shipyards of the United States during the current year. During the fiscal year 1909, 1362 merchant vessels of 232,816 tons were built in American shipyards.

Practical Letters from Our Readers

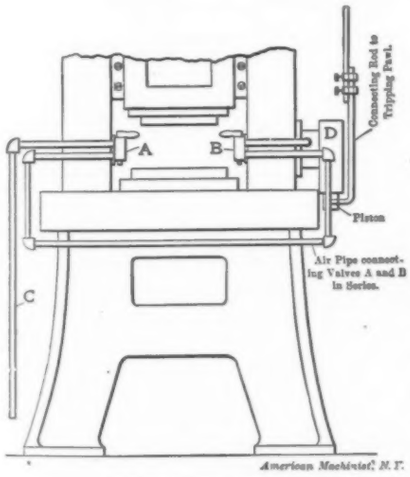
A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

Safety Device for Punch Presses

Many devices have been originated for the purpose of preventing injuries to the operators of punch presses, which are usually due to carelessness which crops out now and then even in the most experienced workmen. By introducing suitable mechanism and making it necessary for the operator to use both hands simultaneously to operate two tripping levers which must be worked together in order to trip the press, many of these accidents have been averted.

For simplicity and cheapness of construction together with high efficiency, the herein described and illustrated device is worthy of attention: The arrangement of parts and method of attachment to a press is clearly shown. *A* and *B* are two taper plug cocks equipped with handles which point in toward the center line of the press. These handles are normally held by suitable springs in such position that the valve *A* is closed, shutting off the air from the supply pipe *C*, which is attached to a source of compressed air.



THE SAFETY DEVICE

The valve *B* is also closed, but this valve has a bypass port which permits the air from the tripping cylinder *D* to exhaust into the atmosphere when the valve is closed.

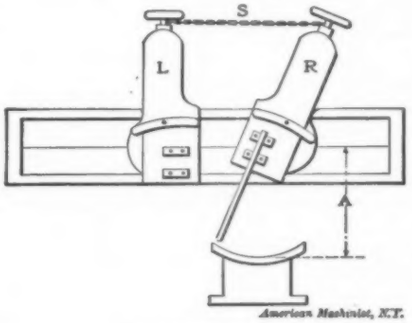
When running the press it is necessary for the operator to grasp both handles and pull them outward at the same time. This movement allows the air to pass from the supply pipe, first through valve *A*, then the valve *B* into the tripping cylinder *D*, where it acts upon a piston which is attached to the tripping-pawl rod of the press and takes the place of the usual foot pedal. It is readily seen that unless both valves are operated together it is impossible for the air to reach the tripping cylinder and trip the press into operation.

This device is capable of being applied to presses of any size, and has the great advantage of not having a large number of moving parts to fit up and to give trouble.

Dayton, O. CLARENCE CARSON.

Planing Arcs

The distance *A* is the radius of the required arc. The tool must be set central



PLANING ARCS

with the swivel. The saddle on *R* is locked to the cross rail, but the swivel is left free to turn. The head *R* is connected to the head *L* by the chain *S*. The cross feed is put on the head *L* and it swings the head *R* and its tool through the arc of a circle.

Warren, Penn. J. R. BAKER.

Laps for Putting a Fine Edge on Metal Cutting Tools

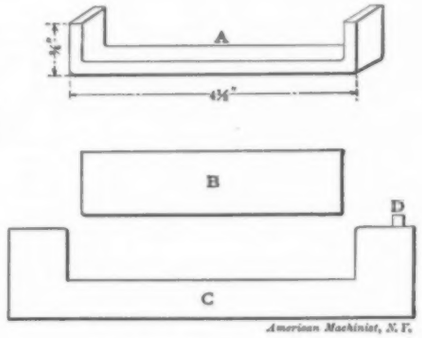
In many continental shops the screw machine and other tools are finish-ground on copper laps. These laps are about 10 inches diameter by about ½ inch thick, and are mounted on the same spindle as the emery wheel. The lap is easily charged in the usual way by using a hardened-steel roller and rolling the abrasive into it.

Tools finish-sharpened in this way will do much better work and will last much longer.

New Bedford, Mass. J. O. SURFACE.

A Simple Bending Jig

We had 316 pieces, as shown at *A*, to make for a winding machine. The stock was cold-rolled steel ⅛x¾ inch. A die *C* was shaped up out of cold-rolled stock and a punch *B* to fit it minus the thickness of the stock to be bent. All corners where the stock drew were rounded off and a stop was put at *D* with two other



THE WORK AND THE JIG

stops not shown for the stock to rest upon.

The die *C* was fastened to one jaw and the punch *B* to the other jaw of a machinist's vise, with the opening in the die in line with the punch. The stock was then cut to length and placed against the stops and a couple of turns of the vise screw bent the stock to shape.

Philadelphia, Penn. W. H. O.

Sawing Thin Brass Tubing in the Hack Saw

Those who have had the job of cutting thin brass or copper tubing with the hack-saw are acquainted with the difficulty usually encountered as a result of the tendency on the part of the saw to bite into the walls of the thin tubing. This difficulty can be easily overcome.

An old hack-saw blade which has outlived its usefulness is all that is necessary, and therefore the method is one that fits in well with shop economy. The teeth of the blade are first ground down with a grinding wheel until only very small teeth projections remain. This blade is then used in the customary manner and will do the work without any difficulty, giving clean-cut results.

Brooklyn, N. Y. P. J. A.

Clamping Devices for Attaching Hangers to I-beams

Wooden beams have been almost entirely eliminated in mill construction, and the illustrations herewith show how hangers for line shafting are generally fastened to steel I-beams. The method shown in Figs. 1, 2 and 3, are used when line shaft runs at a right angle with beams. The method shown in Figs. 4 and 5 are used when line shaft runs parallel with the beams.

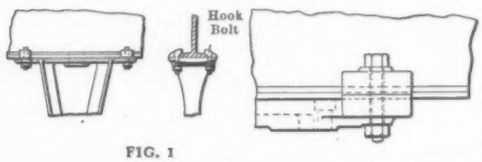


FIG. 1

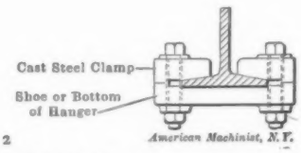


FIG. 2

HANGER ATTACHING DEVICES FOR CONCRETE BEAMS

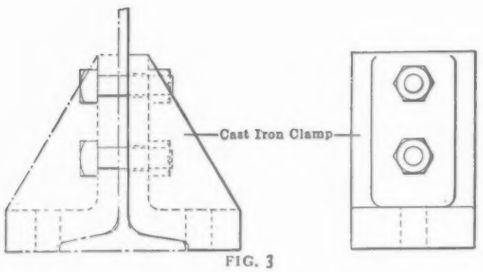


FIG. 3

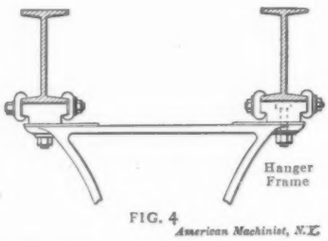


FIG. 4

HANGER ATTACHING DEVICES FOR CONCRETE BEAMS

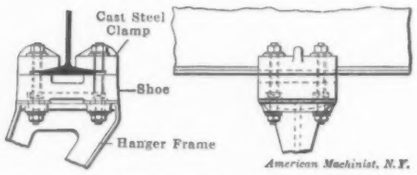


FIG. 5. HANGER ATTACHING DEVICES FOR CONCRETE BEAMS

Aug. W. Wackerman.

Pittsburg, Penn.

A Substitute for a Turret for the Speed Lathe

I don't exactly know what to call the device shown in Fig. 1 because I never saw one like it before. It was formerly used in a watch or clock factory for work such as is done on a speed lathe with a small turret in the tail spindle, or with a half-open tailstock. The body *A*, Fig. 2, is made of tool steel left soft. The tapered end *B* fits the tail spindle of the lathe. At *C* the body is milled to receive the two tempered jaws *C*. The hole *D* is concentric with the body *A* and taper plug *B*. The shank of the tool holder *E* is a snug fit for the hole *D*. The tool holder is drilled at *F* to take the shanks of various tools which are held in place by the blind set screw *G*. There are several of these holders and into them are fitted the various drills, etc., for the operations necessary for finishing the end of a piece of work held in the chuck on the live spindle.

The shank *B* is fitted to the tail spindle and the shank *E*, of the first holder in the series, is pushed into the hole *D*. The end of *F* raises the two jaws *C*, which snap back into position when the two grooves *J* are under them. The shape of the grooves *J* is such that their flat surfaces come against the flat surfaces of the jaws *C*, taking the twist of the tool. When the first operation is completed a partial turn to the right causes the two jaws *C* to slide up on the inclined faces of the grooves *J* when *E* is easily removed and another holder and its tool substituted.

New York. E. A. Dixie.

In a paper presented to the Institute of Metals it was pointed out that elastic failure of mild steel always took place under any system of loading by reason of the sheer stress. Having satisfied himself on that point the author of the paper endeavored to find out whether all other ductile materials followed the same law. He could only say that they appeared to do so, he could produce no exact experimental evidence. The reason was that copper, aluminum, Muntz metal, and various other materials appeared to be much less homogeneous than mild steel. The result of his researches proved that, so far as the elastic properties of the material were concerned, mild steel was much more reliable than other material.

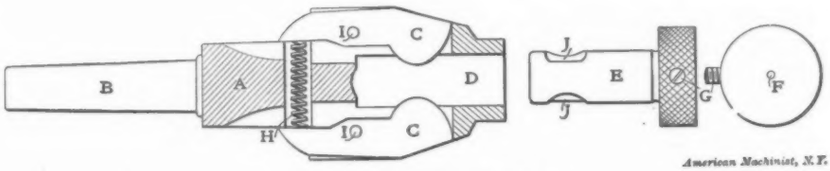


FIG. 2. DETAILS OF THE DEVICE

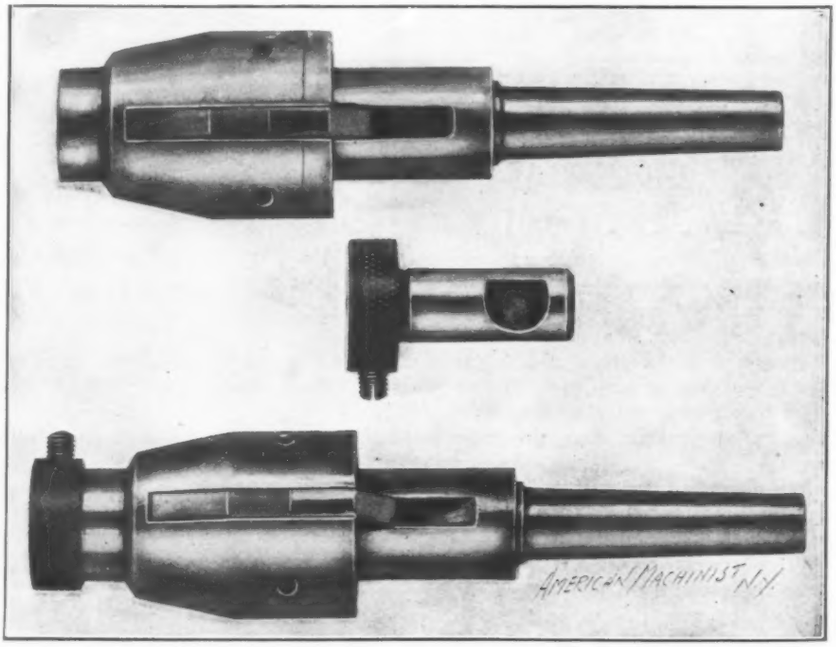


FIG. 1. A SUBSTITUTE FOR A TURRET

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

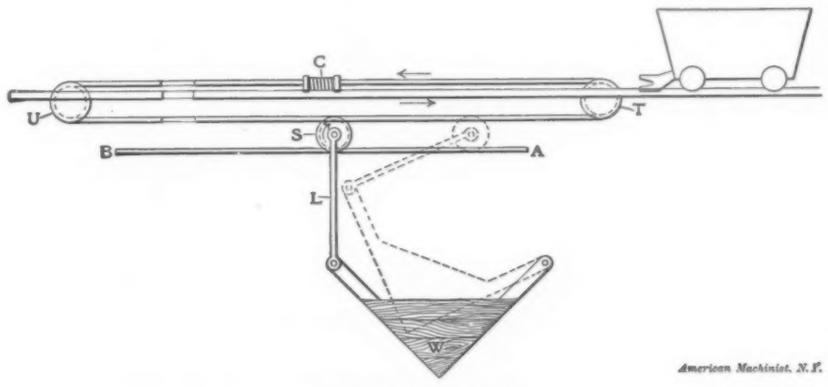
WE PAY FOR THESE ALSO

A Novel Car Dumper

Certain articles which have recently appeared in the AMERICAN MACHINIST relative to coal handling are very interesting and bring to mind a device that is used by the Hudson River Coal Company, at Delanson, N. Y., to transfer coal from their storage and mixing plant to the Delaware & Hudson Company's pockets for use in coaling their locomotives.

The part which is of interest is the car which runs between the mixing plant and the pockets, as it is so arranged that the device uses the material that is being transferred to furnish the motive power to return the empty car to its place of loading.

The mixing plant is about 300 feet from the coal pockets and the track upon which the car runs is several feet higher at the mixer than at the coal end. The track is level at the point where the car stands while being loaded at the mixer by a two-ton capacity bucket, which just fills the car. The latter is pushed by hand until it is at a point on the inclined track where it will run alone. Its speed, of course, increases as it runs down the inclined track and it is going at quite a high rate of speed when it strikes the clamp block *C*, with its picking-up piece, on the forward end of the car.



A NOVEL CAR DUMPER

This clamp block has a piece at the left-hand end, as shown in the sketch, which is clamped solidly to the cable and between this piece and the piece on the right, which is the one against which the car strikes, are springs which absorb a portion of the shock. The car goes on carrying the block before it until it raises the swinging weight *W*, as indicated by the dotted lines. The weight gradually brings the car to a stop at one of the pockets, the car having run against a tripping device just before stopping, which allows the side door of the car, hinged at the top, to open and drop its contents down into the pockets.

As soon as the car is empty its weight being much less than before, it is quickly started backward by the swinging weight pulling against it through the cable and clamp block. The clamp block now follows the car back considerably beyond the point where the car first picked it up and oscillates forward and backward several times, each swing becoming shorter until it finally stops at the point from which it first started, with the links *L* in a vertical position. Meanwhile the empty car has gone back up the inclined track to its starting point, it having received just enough push by the swinging weight, to do this. The swinging weight is composed of a wood trough filled with concrete.

One end of the cable is fastened to the end *A* of the track upon which the sheave and wheels *S* run; then passes around the sheave *S*, runs off to the right, around the sheave *T*, thence to the left through the clamp block *C*, around the sheaves *U* and *S* and is finally fastened to the end of the track at *B*. When the car first strikes the clamp block the cable moves quite easily for two reasons: First, the sheave *S* moves only half as fast as the clamp block and, secondly, the links *L* which support the swinging weight are in a vertical position and can be moved by very little force from this central position. It, however, requires a rapidly increasing force to move it as it leaves this central position, so that in spite of the fact that the car strikes the block with a heavy blow, the shock is well taken care of and does not injure the parts.

The clamp block is moved to different positions on the cable and the tripping device to different points on the track, to stop and unload the car at the desired pocket.

MARTIN H. BALL.

Watervliet, N. Y.

The Commercial Value of Patents

I cannot tell, even in several readings of Mr. Knipe's article, on page 545, whether it is just satire—highly polished and well sustained satire—or whether he really means it as a suggestion to the powers that be in the United States Patent Office.

If the former, let the advocates of the very paternalistic government which is at present trying to throttle workaday industry answer Mr. Knipe. He would seem to be fair game for the bureaucracy. If the latter, I would respectfully submit a different view of this matter for the serious consideration of Mr. Knipe and your readers.

First, I am inclined to deny that inventors and farmers are similar classes in any equivalent sense. A country can get along without inventors, not without farmers. Witness China, a country which has solved with very considerable success the problem of sustaining an enormous population within a limited territory upon a basis largely agricultural. Witness Japan, where intensive farming and not invention has solved the very problem of existence.

(As to the Agricultural Department at Washington, its value, if it is able to prove it, is all that is needed to demonstrate to the querist the need for its existing.)

Second, if you are going to allow and authorize the Patent Office *to issue digests of the subclasses,* it is difficult to see how you can avoid in the course of time the acceptance of these digests as the *most authorative basis for the actual state of the art in any one of the subclasses at the time of issue.* They will come to have a value far beyond their deserts, and will hamper invention and limit inventors. *I deny to the Patent Office staff the necessary ability to make such digests in a manner acceptable to those most intimately associated with the various arts.* And this is a conviction in which I believe I will

find support from those who have actually dealt with the Patent Office at close range in the highly developed arts.

We would find gradually an actual constriction arising from the mere acceptance of these digests as final and authoritative statements; I doubt whether they would teach anything to those who were intimately familiar with any art; I certainly doubt whether they would teach anything to those unfamiliar with the arts.

I should not be understood as asserting the final perfection of the Patent Office as at present constituted; nothing is further from my thought. It is capable of being improved in probably a score of ways with very considerable benefit to inventors. The present form of publication of the *Gazette* with its mutilated patents will always be an unending source of expense to the individual inventor, and an unmerited advantage to the large corporation. The list of classification is now, even to the trained eye, a mere series of unmeaning titles. If followed by explanatory notes and bracketed sub-sub-classifications they might be of value—and if each subclass were given a brief explanatory preface as to its scope one might be able to tell occasionally when and where to buy a whole subclass. As a matter of fact, in the intricate and complex arts and machines, it is just as safe to spend $15 on an application at the beginning, and find out from the first rejection just what the examiner overlooked, as it is to spend $5 to $10 on a search that may or may not have been effective, and then put in an application to discover that the examiner has apparently never had brought to his attention some early or obscure patents you were most afraid of.

If, as Mr. Knipe says, "Patentees are entitled to shops and laboratories where they can develop ideas that the department decides have patentable features," there is absolutely nothing to prevent those large manufacturing companies whose chief assets are their patent monopolies from securing control of such shops and getting their experimental work done for nothing. And what is your poor inventor going to do with the invention of which he has a dim glimmer in his mind, if the department decides from his description of it that it does *not* "have patentable features?"

A young farmer with a training in an agricultural college is an asset of unundoubted value to any country. I am not at all sure, however, that the majority of inventors belong in his class. With all respect to inventors, I see nothing on which they can base any such claim. What else did the AMERICAN MACHINIST'S recent investigation teach? Their value fluctuates from zero and less, to any imaginable figure, but it tends to keep closely to the zero point. Sometimes I call myself a designer, and sometimes

New York City. A PSEUDO-INVENTOR.

Notes on the Design of an Engine Lathe

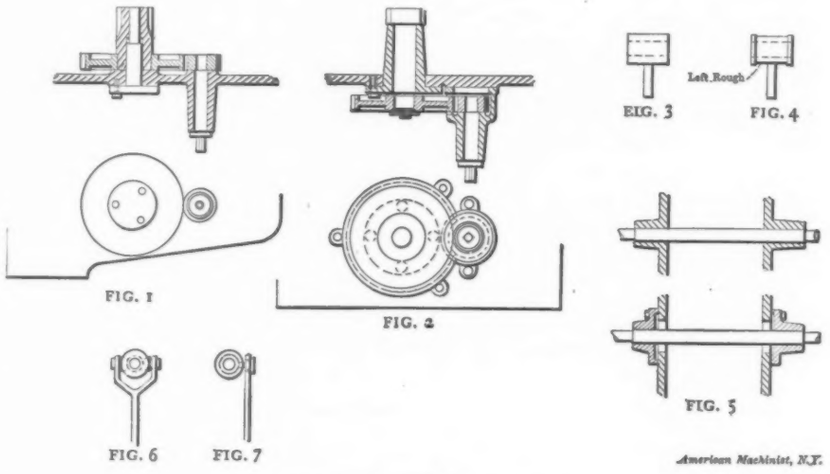
Entropy's article on page 363 brought to mind experiences I went through at the introduction of high-speed steels. To keep the shop going, which was a small one with a very limited capital, it was perfectly clear that to keep our customers' names on the book we should have to supply much more powerful lathes. Our customers expected a high-speed lathe from us at the same figure we had got from them before for carbon-steel lathes, therein lay our chief difficulty.

Our directors would not hear of investing more money; they being no way engaged in the engineering line, it was natural that they could not comprehend the changes this steel would bring about. We decided, therefore, to reconstruct our existing designs, making the lathes more powerful and to add strength where thought necessary, also to go through all the details and try to cheapen the production to bring down the cost to equalize the expense these alterations curtailed.

Our 12-inch center lathe was attended to first; this size comprised our staple trade. In the headstock we knocked one step off the cone to allow for a wider belt as we made it the same length overall as previously, also made it larger in diameter, there being plenty of clearance underneath. Large bearings seemed to be a good selling point, so we put in a much larger spindle and the extra price these forgings cost gave our secretary a bad attack of nerves. We tried making them out of bars, the front bearing being 1 inch larger in diameter than the spindle nose left a decent shoulder; but alas, we soon found our mistake. One of our customers returned a spindle with a 36-inch faceplate fast on the nose, which we finally had to turn off in the lathe. Also we found this small shoulder did not keep the plate square, so we went back to spindles forged with a large collar on the end.

We turned the insides of our cones, as we found it much cheaper than balancing by lead, such a large quantity being necessary. There did not seem to be anything else we could alter on the headstock without making a new pattern, which was out of the question. We practically left the loose headstock alone except for putting in an extra holding-down bolt. We then had three and the headstock being of heavy build we considered it quite modern.

Then we tackled the saddle. It had an overhung rack pinion, as shown in Fig. 1. All agreed this was a weak place and we got over it, as shown in Fig. 2. Here we got a pinion forged solid with its shaft and also was able to support it right up to the rack. The front of the saddle we made square, see Figs. 1 and 2. This added to its appearance and was much easier set for machining. The guide



DETAILS OF ENGINE LATHE DESIGN

screw had a half nut; we then got from one casting sufficient for two lathes. The bearings of the surfacing screw were as shown in Fig. 3. After being turned they went to the shaper, as it was impossible to turn the full length owing to the projecting stud being malleable casting, we altered the pattern as shown in Fig. 4. This improved things, no shaping operation being necessary and required no finishing by hand.

The compound rest was only cored out to allow merest clearance for the nut, as our market was principally among marine shops, and these people seem to think less of knocking a few square inches off to allow something to clear than in forging a longer tool. Therefore, we had learned from previous experience what our rest had to be and were confident that no high-speed steel would shatter that portion. All we economized in this detail was to buy the tool clamps in bright-drawn bars and cut off to length in a machine hacksaw.

On our smaller lathes we had to make the top slide of steel, for when fixing a tool, if cast iron, this part buckled and locked on its slide and would not move by hand. As our lathes were of the English type the feed-gear box was at the back, the changes being operated by a lever in front. This necessitated a shaft passing through the bed, as in Fig. 5. To bore these bearings was a troublesome job so we made them loose, bored them on the drill press and chipped them into position.

The lever for moving the sliding key shaft was forked at the end, as shown in Fig. 6. We altered this, as in Fig. 7, which operated equally as well. The quadrant for positioning the front feed lever was previously cast to bed; this was an unsightly projection, so we made it a separate casting which could be finished at the drill press without the need of resorting to a breast drill, which was necessary in the former case. This casting was screwed to the top of the bed, thus the holes could be drilled at the same setting as the holding-down bolt holes for headstock were drilled. As for the bed we took a tip from our American friends and made it lighter by altering the core boxes. We took five hundredweight of metal away and then we thought it was possible to get more and still have a substantial design.

Every brass and gunmetal casting was made as light as possible and perhaps lighter than what was practicable. With the above alterations our lathes found a brisk market and work aside some built by the most celebrated makers. They are on the same class of work and give satisfaction. Draftsmen should read Entropy's article with interest and when getting out new designs remember that novel details should be sacrificed for cheapness of production.

Gainsborough, England. YORK.

A Power Friction Stud Driver with Compensating Feed and Automatic Release

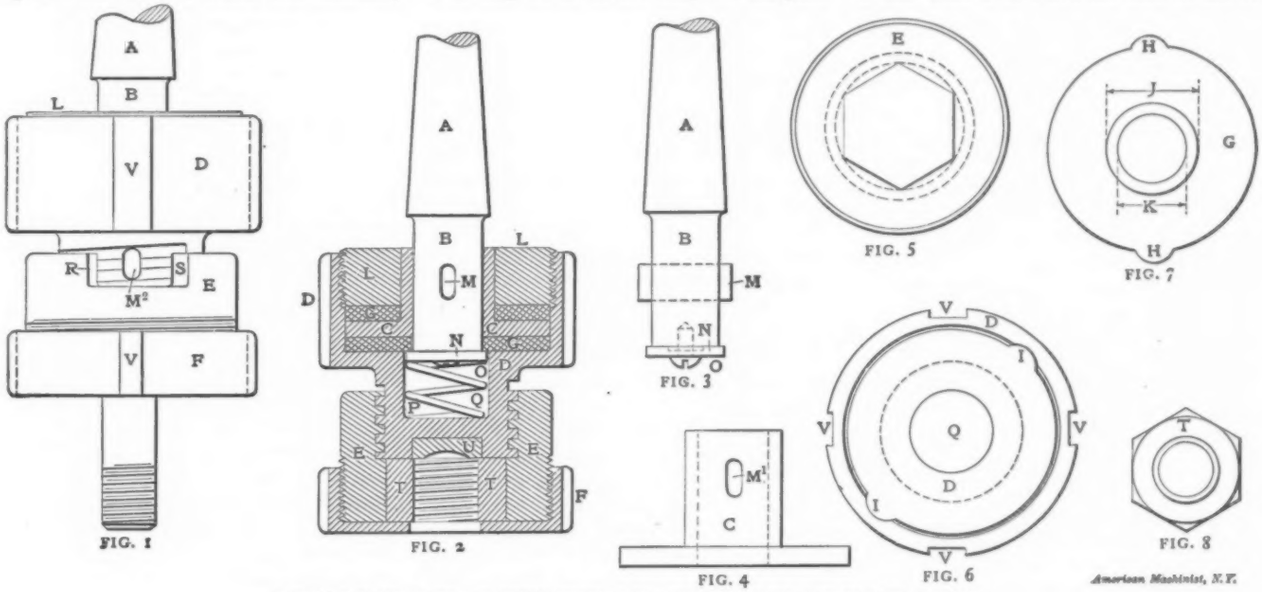
On page 289, a correspondent gave a description of a power stud-driving attachment for the drilling machine. This device interested me as it is an operation that is generally performed by hand—and consequently expensive.

The attachment described on page 289, while an advance on hand work, in my opinion leaves room for many improvements. The method of driving being positive must sooner or later result in broken studs and spoilt work. It must require a very skilful operator to run it, so as to reverse just at the right moment. Nothing is provided to tell him that the studs are all uniformly tight when driven. Some of them may be on the point of bursting a casting while others may be comparatively slack. As there is no compensating device, it is probable that some of the threads on the top of the stud will be stripped or damaged by the spindle not being fed the same as the pitch of the thread on the bottom end of the stud.

Figs. 1 to 8, shown herewith, illustrate a stud driver with all the above bad features eliminated. It also possesses many improvements over the one shown by J. Crosby on page 289. In many other respects it is very similar to many others I have seen.

Fig. 1 shows the studder complete, with a stud in position for driving. Fig. 2 shows a section, with the stud removed. *A* is the Morse taper steel shank parallel at the bottom end, as shown at *B*. *C* is the steel driving plate, shown also at Fig. 4. This is bored a nice sliding fit on *B*. *D* is a steel body with a square thread cut on the bottom, on to which the steel box *E* is screwed. *F* is a retaining nut, screwed on *E* with a fine thread as shown. *G G* are two vulcanized fiber driving washers, also shown in plan at Fig. 7, the top one being bored as indicated by the dimension *J*, to fit on the sleeve on *C*. The bottom one is slightly less, as indicated by *K*, to fit on *B*. The two projections *H H* are for driving purposes, and fit in the two recesses *I I*, shown in the plan of *D*, at Fig. 6. These two recesses are milled in with a vertical miller. *L* is a nut screwed into *D*, as shown, by a spanner. It drives *D* by friction between the two fiber washers *G* and the flanged sleeve *C* through the medium of the cotter *M* passing through the long cotter hole *M'*, in *C*, shown at Fig. 4. This cotter hole is about ½ inch longer than the cotter *M* to provide a compensating movement when feeding down or withdrawing. This is a safety valve preventing broken studs and damaged work. The nut *L* is tightened until there is sufficient friction to drive the stud to the requisite degree of tightness, at which point it slips and leaves the stud stationary. *M2*, in Fig. 1, shows the method of driving the stud box, exactly as shown on page 289, by the cotter coming in contact with the faces *R* and *S*. *N* is a steel washer, secured by the screw *O*, on the end of *B*, to prevent it from being drawn out of *C*, when withdrawing. *P* is a spring, which fits in the hole *Q*, for keeping the shank in position. When studding, this spring is compressed, and gives a compensating feed, so that it is not necessary for the operator to feed the spindle down at exactly the same speed as the pitch of stud being driven.

T is a casehardened hexagon nut, which fits inside the hexagon hole in *E*, as shown in Fig. 5. It is held in position by the retainer *F*. These nuts are, of course, interchangeable so that only one body is required to accommodate several sizes of studs. *U* is the brass piece for the stud end to engage against. *V*, in *D* and *F*,



A FRICTION STUD DRIVER WITH COMPENSATING FEED AND AUTOMATIC RELEASE

are for adjusting spanners to fit in, to adjust the driving friction washers.

This studder has been in use some time and is quite satisfactory, and although more expensive to make than the one shown on page 289, it is far safer to use. It is practically impossible to damage work with it if the friction is properly adjusted and one body will accommodate several different sizes of studs, whereas in the one shown by your correspondent a separate stud box complete is required for each size of stud which makes it more expensive if a full line of studs have to be provided for.

J. WYNNE ELLISSON.

Milwaukee, Wisconsin.

Inventing and Patenting

There is no disputing the contention that anyone having "worth while experience" with patents knows that the cost of a patent exceeds $65. Such a figure is too low to cover reasonable service in the prosecution of the patent application plus the attendant fees, and is certainly too low to cover inventional work besides. The inventional cost is no more a component of the patent cost than the cost of a trolley line is a component of the cost of the charter under which it operates. The accepted forms of assignment refer to the sale of the invention and of the letters patent. Further, just as the value of the charter or franchise is not based either upon its own intrinsic cost or that of the utility which is operated under it, so the value of a patent is not predicated upon the cost of securing it or upon the cost of developing the invention which it covers. Answering the hypothetical question presented, I should not consider such a proposition as that presented by Mr. Alford, but admitting that I did for the sake of the argument, I should expect to receive the $1500 and not $5700.

There is ample room to doubt the prevalence of a belief among the class of readers addressed by the AMERICAN MACHINIST that $65, as cost of a patent covers the charges for drawings, patterns, models and general development, in any sense. More than once have I heard shop men express their realization of the fact that patent cost is but a part of the cost of getting up a new device. Mr. Alford says that the casual reader might infer such to be the case, but the only deduction to be drawn from this is that the casual reader should read carefully. If a workman misreads a blueprint and makes a mistake because he read only casually, the fact is no extenuation for the workman, and the print may not be necessarily accounted defective or misleading.

In the first place inventing is no game, to be played as the race track and stock market are played, and those who would make it such have no room for consideration here. Rather, it is a vocation, to be developed just as the talents of the artist and composer and author are developed—by study and practice. Indeed, the real inventor is an artist in mechanism, or electrical or chemical effect, according to his individual sphere of action. Therefore, if the financial returns from inventing appear meager it seems better to ascertain and, if possible, remove the cause than to utterly dissuade from a valuable and legitimate field of effort. One of the prime causes for financial disappointment is the misdirection of effort. The would-be inventor clothes an unsubstantial conception with unwarranted value, and without due consideration wastes time and money in attempted negotiations or in starting manufacture. Possessing no intrinsic worth the project falls flat.

INVENTIONS VERSUS INNOVATIONS

As Mr. Johnson says in his communication, many attempt to treat as inventions constructions which are no more than the products of what the patent office terms "ordinary mechanical skill."

Too many devices, termed inventions, are simply innovations and mere innovation bears about the same relation to real invention that the fruit of the pasture tree bears to that of the orchard. Generically the fruit of both may be apples, of distinctly different value. For example, an inventor achieves a given result after a patient consideration of the conditions involved, and the final embodiment contains distinct mechanisms, all of which are co-related, and each of which presents its own problem. For each of these problems there is a possible solution and a group of near solutions. The inventor's procedure is selective. If he possesses great skill and technique he selects the solution; if he falls short of this he selects the nearest solution that is satisfactory to his analysis. After his ultimate result has been achieved others of fairly resourceful mind see one or more of the more readily to be apprehended near solutions, that the inventor has discarded, and proclaim them as matters which the inventor has overlooked and which their discerning minds have discerned. Perhaps they patent them, but they fail to secure reimbursement for their efforts and wonder why. Perhaps they berate the inventor as selfish and bigoted because he will not adopt and pay for their notions.

A little thoughtful contemplation should answer their queries, reminding them that the mind which consummated the entire machine, had probably discerned and considered what they thought they had discovered. That device lacked constructive value because it did not fit into the orderly scheme of the inventor, and therefore it lacked commercial value. As an illustration, an inventor selects a mechanism for moving a given element between two positions. His selection is made with due consideration of the influence of inertia and momentum, the demands of speed, the advisability of uniform or accellerated motion and particularly of the related mechanism. The innovator sees other means for moving the same element from one position to the other, but because these finer analytical considerations escape him, his device is too slow of action, too susceptible to wear, does not perform harmoniously with related devices and is generally inadequate. In short, if working with an inventor it is wise to give him credit for thinking along broadgage lines, that probably comprehend any bright schemes liable to pop into the novice's head, and the same principle holds good when endeavoring to invent in a field where an inventor of great skill has already wrought.

One of the first principles to be learned, therefore, by the would-be inventor is that present-day invention is more a matter of thoughtful analysis than of haphazard inspiration. Sometimes, but seldom, happy thoughts are gold mines.

As close analysis demands suitable premises from which to start, it is desirable that he who would launch an invention should have a working knowledge of the art in which his invention is to be effective. It is productive of chagrin as well as cost to precipitate a new machine upon the mechanical world only to find that it has been based upon misinformation. Men have been led to improve machines, and subsequently learned that the subject of their endeavors was of ancient vintage; that later developments of the same machine not only overcame the insufficiencies seen by the would-be inventor but went way beyond anything he contemplated.

Another source and cause of cost is the entrance upon a field of endeavor that has been long and widely cultivated. Chance ideas have small likelihood of success with an old subject. There has recently appeared a new shoe-polishing device in the *Patent Office Gazette*, but I purchased the counterpart of it in the open market over ten years ago. Consider the subject of quick-adjusting wrenches. There are so many kinds of the same thing that one may well wonder how the patents for them get through the patent office. We get sometimes several letters a week from men who are sure that they have the long needed "quick adjuster." Several years ago, we had a letter from a young man, accompanied by a model which had been whittled out of pieces of a cigar box. On writing and explaining the situation, he responded, thanking us for the information, saying that he could ill afford to prosecute the matter anyway, but that he had not supposed such a wrench had been thought of. If he and a multitude like him would only pause to consider the length of time that wrenches have been in use, the simplicity of a pawl-and-ratchet adjustment, and

the likelihood that someone must have thought of the substitution of such a device for the usual nut, they would not waste time and money on so barren a prospect.

Why Are Fewer Patents Issued to New Englanders than Formerly?

A local paper brought out a statement in its columns that the proverbial "Yankee ingenuity" was on the wane, as evidenced by the fact that fewer patents are taken out in New England than in the newer communities. An explanation was advanced that many of the patents taken out in the newer communities were either for devices which in New England are recognized as "part and parcel" of shop practice, or for such utilities as fan attachments for rocking chairs and kindred notions that Yankeedom had years ago abandoned as beneath the plane of effective ingenuity. That there may be something in the first portion of the explanation is evidenced by the letters from your contributers. Occasionally attention is directed to the fact that a supposedly new "kink" has been in use either years ago or for years in some old established shop.

A greater wrong is perpetrated by those solicitors of patents whose slogan is "Patent your ideas," than by those who advertise that patents can be procured for $65. If the general public could only be weaned or divorced from the notion that ideas are patentable, there would be fewer patents taken out.

Patentees and applicants for patents frequently sustain needless expense because of premature and ill judged commercial exploitation of their inventions. Sometimes an oversanguine inventor initiates manufacture before his letters patent are actually granted. Manufacturing equipment is costly, and should not be undertaken before there is reasonable certainty that it will be available.

Real Position of the Attorney

Finally, inventing sometimes proves costly because there is not exercised sufficient care in the prosecution of the patent application. Much of this devolves essentially upon the inventor himself but he does not realize this. The patent attorney is of the same category as the model maker. One is the constructor of the embodiment of the inventor's conceptions; the other is the constructor of the legal shelter under which those conceptions and their embodiment are housed and sheltered. One fabricates in wood and metal, the other in language. One is skilful with the implements and apparatus of physical construction, the other with the terminology and formularies of legal construction. But whereas the inventor delves into infinite detail with his model maker, he too frequently turns the model or drawings over to his attorney with a curt—"Patent it." He reads the application over casually, and if anything goes amiss takes refuge behind the assertion that he thought the attorney knew his business and, therefore, he left it all to him. Now it is far easier and less costly to remedy an error of dimension or even of proportion in a model or machine than it is to correct errors of insufficiency in a patent application. Therefore, superlative care should be exercised to give the patent attorney the fullest kind of information, replete with all the whys and wherefores at the inventor's command.

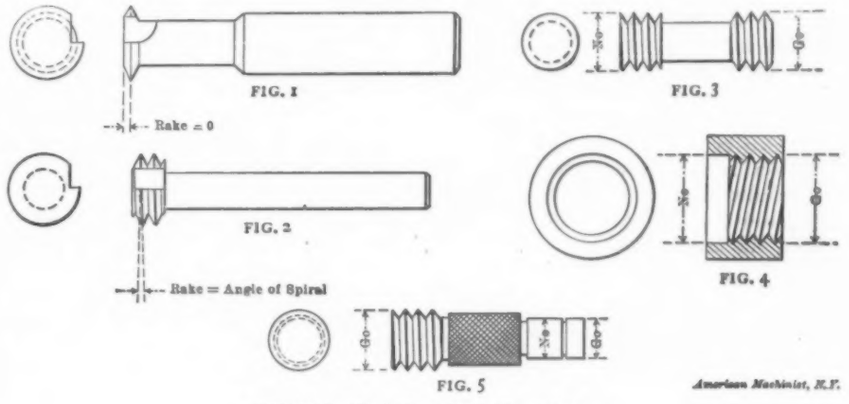
It has been my lot (rather than fortune) to come in contact with several patents which were deficient in scope, apparently through no other cause than carelessness on the part of the inventors, and because they were deficient in scope, they were deficient in commercial worth. There are some advertising solicitors who lay stress on the fact that they submit the applications to their clients so they may see just what is being done. The tone of this announcement is that of conferring a great privilege upon the client who, if he would only read the rules of practice, would ascertain that his application can be thrown out of office if it can be proved that he has signed his application without reading it. (Rule No. 31).

I believe that the field of invention is a good one to cultivate, if it is only cultivated in a rational manner. One of Mr. Alford's correspondents complains that his inventions have proved to be only "pot boilers." What of it? There are many who would be only too thankful if they could make the pot boil. I have seen men who received $100 or $200 or perhaps $300 for inventions that did not cost them in actual expenditure over $5. That is certainly a good investment, especially for a novice. We have all seen apprentices pointed out as being able to do better work than some of their journeyman associates, but they were not bitter because they were not getting journeymens' pay. The apprenticeship to invention is longer, as a rule, than that to the machinist's trade. It is for those who have a natural aptitude for conceiving new and valuable things, but as in the case of the painter and the composer, the best results come only after the acquirement of skill and technique. There may be mechanical Beethovens and Mozarts but they are few and far between. In fine, if the subject of invention is treated with the same care and circumspection as are other subjects on which commercial values are based, there will be less complaint as to lack of financial returns.

Central Falls, R. I. E. C. S.

Internal Threading Tools

An article appears at page 417, dealing with the threading of female gages. The idea of holding the fixture which contains the threading tool at an angle on the compound slide, then swiveling through the same number of degrees which brings the threading tool in line with the axis of the work, and then feeding in with the compound rest, which has the advantage of bringing the whole of the friction and stress on the front edge of the threading tool, is a very good one, and providing the cutting tool is all right a thread should be produced more rapidly than with the method of feeding it at right angles.



INTERNAL THREAD TOOLS AND GAGES

Mr. Guild's threading tools, Figs. 2 and 3, which I reproduce here in Fig. 1, appear to warrant a little criticism. If I read the sketch right the cutting portion is a circular disk with the form of thread turned on its periphery, as in Fig. 1, thus making a circular single-point tool, but minus the clearance necessary to give sufficient "sweetness" to the cut. We all know if we are making an ordinary single-point threading tool for the lathe we pay particular attention to the "rake" of the front cutting edge. Mr. Guild's threading tool appears to be without the necessary "rake." Now a very good tool in my opinion is one which is nearly identical with Fig. 1, the difference being that the tool is in the shape of a thread on its periphery, Fig. 2, and chased with a correct chaser the pitch and form of the thread to be cut. Thus

is obtained a tool which is at once a nice cutting tool and a chaser combined, and it also does away with the facing up of another tool to give the necessary shape at top and bottom of thread, according to the standard to be cut.

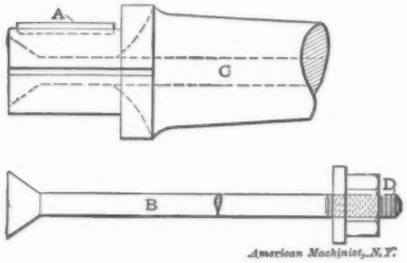
For obtaining the correct size top and bottom of thread in a female gage a good way is to make a "No and Go" gage, Fig. 3, which is finished with the same chaser (or any correct one) as the threading tool was chased with. Then by making the "Go" end 0.0005 inch under the correct size, and the "No" end 0.0005 over the correct size, it will be found that by letting in the "Go" end—but not the "No" end—a gage will be produced as near the correct size as is possible. A big help in striking the correct size is before threading the gage to turn the correct diameter at the bottom of the thread for about ⅛ inch and use this as a guide.

A good class of female thread gages for work where a limit is allowed is like Fig. 4, with a threaded end maximum size, which we call "Go," and a plain end minimum size called "No." For plug-thread gages like Fig. 5, there are two sizes on the plain end; minimum size at bottom of thread called "Go" and maximum size at bottom of thread called "No." By letting the "Go" end enter, the operator can then start threading with the assurance that by working up a full thread, he will not be far from correct size. The threaded end is made to work in conjunction with the "No" plain end, the first to enter, the latter should not enter. This type of gage has the advantage of rejecting work which is not up to a perfectly full thread.

Coventry, England. H. CHINN.

Expanding Mandrels

Referring to the article on the above subject on page 419, I, like Mr. Crossley, took the hint and made one, only I wanted to use it on the milling machine to hold straddle mills for face work, but



AN EXPANDING MANDREL

found the cutters slipped. I made the one shown in the line cut

The keyway *A* prevents the cutter from slipping. The screw *B* reaches through the hole in the arbor and clear to the back end of the milling-machine spindle, which is of course hollow.

The nut *E* bears against the end of the spindle, draws the taper head of *B* in expanding the arbor tight in the cutter. It also prevents the arbor from working out of the spindle.

W. F. YEATES.

Northampton, England.

The Question of Training Apprentices

On page 213 is an article on the "training" of apprentices. In it there are one or two points which so far coincide with my own views, that I feel like supplementing it with a few remarks on the impressions which I have obtained by being in close touch and by carefully observing those apprentices who have, as well as those who have not, had the advantage of technical training. One of the strong points of the article is the remark on the teacher; it is there stated that any college man is sure to be a failure. That this is so is only to be expected by those who are conversant with the conditions and requirements of the trade or profession.

It may be that the college man has been through the "shops," but what does that mean? In 99 cases out of a 100 the man has gone into the shop with certain preconceived notions of the dignity of the trade generally, overlooking or ignoring the fact that there is a practical as well as a technical side of the business to be taken into account. This is just where the majority of them fail, and the result is shown by the product in the form of, so called, technical trained apprentices.

There is no question about the technical training being all right in itself, but unless it can with advantage be used by applying the same to the everyday work, then it has been so much time—and precious time at that—wasted.

My experience with apprentices, and it is the experience of others to whom I have mentioned the subject, is not to the credit of the technically taught class but rather the reverse. I have had, and still have to deal with both kinds. Of the two I prefer the nontechnical lad as being the more useful. Perhaps it is that the system of training is at fault, or it may be the teacher; whichever it is something requires doing to remedy it.

There are several defects that require looking into; one has already been mentioned, namely, the inability of the student to apply his knowledge to profitable account on the work he has in hand. Another is that he is either careless or lacks the necessary skill and energy he ought to put into his job. In many instances the lads are spoiled by getting an exaggerated idea of their own importance. As soon as the idea gets into their heads that they are doing well at the figuring, etc., all interest in the practical part appears to cease, manual labor becomes a fag and, only too often, soiled hands are looked upon as being beneath their dignity. When once this idea takes root in the student's mind he may as well give up all thoughts of becoming a thoroughbred engineer for he will be of no use at the draft board, and worse than useless at the bench.

I am going off the book now; I have had them and been glad to get rid of them. Although it cannot be denied that a number have profited by it, on the other hand it may be contended that, judging by past experience, these would have come to the front under almost any conditions.

Then again there appears to be an evolution going on in the bearing of apprentices toward the men with whom, for the time being, they are working. Something of the same kind is perceptible in the manners of present-day children toward their parents. A sort of feeling of superiority, if not actual contempt, is engendered by the system of present-day education; when this feeling is reciprocated it is bad for the apprentice. The knowledge which he will get then will have to be gained in spite of, and not because of, his technical training.

Nevertheless, there is not the slightest reason why the two phases of engineering should not go hand in hand. It is only a question of the right kind of teacher adopting the right system of education. There is one thing which ought to be kept well to the front, something that seems well known but, nevertheless, cannot be too often reiterated, and that is the importance of practical knowledge, and its close relationship to theory, letting the student understand that there is still some reason for the assertion that an ounce of practice is worth a pound of theory; there are numerous cases which could be mentioned in support of this. One instance is the matter of preparing and mixing metals for casting. It may be that we know what metals and percentages should give the best results, but unless we know how to manipulate them in the melting pot we are not likely to get what we expect. It is another example of Opie's reply about mixing the paint (metals) with brains. It is quite evident that Opie knew a thing or two.

Theory says, "if we do so and so such and such will be the result;" but will it? Perhaps it would if everything were perfect, but among other things, the human element must be taken into account. The knowledge of applying theory to practice can only be learned in the school of experience, and the more the student is given to understand that experience can only be obtained by practice, also that the best teacher in this line is the workman at the bench, the better it will be for him.

A little more respct for the workman's blouse is what is wanted in the present-day student apprentice.

Horwich, England. W. PETERS.

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Liability Insurance

A member of the Minnesota Employees' Compensation Commission, George M. Gillette, in a recent address before the Liability Insurance Association said many things that one can put in his pipe and smoke.

"The dangers lurking about the workmen today are a thousand-fold greater than were those about the workmen of even a century ago. . . . . Twenty-two foreign countries have adapted their laws to the new conditions, and only in America, of all the civilized countries, may be found a government of people, civilized, white and free, which has failed to respond to its duties."

"I am of the opinion that there is no question now before the American people pressing for solution which more vitally affects the welfare of society at large."

"In Massachusetts the companies writing industrial insurance have paid back to the employees in compensation only $21,000,000 out of $61,000,000 collected in premiums."

"If the statistics quoted are accurate and my deductions be true not over 20 or 25 per cent. of the contributions of the employer finds its way to the relief of the injured employee."

"In Germany under the operation of a compensation act 78.5 per cent. of the total receipts are paid out in compensation to employees."

"Commissions are now considering this subject in the States of New York, Illinois, Wisconsin and Minnesota."

The average employer is interested in the welfare of his employees and is willing to spend some money to aid them. Recall the welfare work that has been done in all parts of this country during the last 10 years. Most employers pay premiums to some liability-insurance company and of the money thus spent only from 1/5 to 1/4 ever reaches the employees who are injured. From 3/4 to 4/5 of this amount keeps the insurance companies going and pays lawyers' fees. As far as the employees themselves are concerned, the men in whom the employer is interested at first hand, the premium money of the employer is wasted.

Liability insurance is on a radically dif ferent basis from all other kinds. In all other kinds of insurance the policy holder has every incentive to consider the amount to be paid by the insurance company as a return for the premiums, while in the liability insurance he has no such incentive. Fire insurance, for example, is taken out in order that the policy holder may receive a sum of money in case of fire, while life insurance is taken out in order that the dependents of the insured may receive a sum of money in case of his death, the amount paid in both cases being of immediate personal concern to the party who pays the premiums.

In liability insurance, on the other hand, the insured takes out a policy in order to protect himself from damage suits, which are too frequently conducted by lawyers of the class that has come to be known as ambulance chasers, the insured party having no business interest in the amount paid to the real sufferers and no business reason for safeguarding or defending their interests, the pecuniary question which confronts him being—is the premium cost less than the probable cost of paying just and defending unjust claims? If the answer is in the affirmative, then the taking out of liability insurance is a good business proposition, regardless of payments made to the sufferers by the insurance companies. The policy holder may, indeed, have a humanitarian interest in the amounts thus paid, but he can have no business interest.

On the other hand the insurance company does not have to deal with a party who has paid it money expecting ultimate adequate compensation in return, but with another who has no claims upon it, and frequently no means of contesting for his rights. The company is left to settle each case on the best terms it can make, and frequently with a distracted widow, and under these circumstances it is not strange that the amounts paid are frequently beggarly.

Intelligent employers are no better satisfied with these conditions than are its immediate victims. Confronted as they are with the ambulance chaser who risks nothing and who lives by preying upon others—his clients no less than his opponents for it is doubtful, if, in the long run, the victims of accidents receive more through their lawyers than they do from the liability-insurance companies—employers are practically compelled to patronize the insurance companies. But the appalling waste and the fact that so little of the premium money ever reaches those whom it is supposed to reach must appeal to them as well as to those who receive the pitiful sums paid in the settlement of claims.

Handling Heavy Work without Cranes

It's a pretty safe saying that we usually overdo anything we undertake in the way of improvements. The introducer is and must be an enthusiast and he continually sees new possibilities, many of which are not practical or economical.

When compressed air began to be used in railroad shops it spread like wildfire until you found, not only hoists and air tools but compressed-air vises, door openers, turntable motors and other applications which have long since given way to means better adapted for these special places, in spite of the growing use of compressed air in nearly all industries.

The same can be said of many applications of electricity, all tending to show that we swing the pendulum too far in order to let it come back to a happy medium as can be seen in the case of the unwarranted application of gear boxes to many machines.

There is another subject which may be open to criticism in some places at present—the over or unwarranted use of cranes for handling material, and while this is less liable to abuse than some of the other things mentioned, it is worth looking into.

While the days of picking up a hand saw on the hook of a 100-ton crane and carrying it down into the shop while the man waited, have largely gone by, there is still a tendency to install cranes in some places where their economy is doubtful. In the shop itself there is little criticism to offer as the floor space must be utilized to best advantage with machine tools and the work must, in many cases, be literally lowered into place. This means a crane or cranes of sufficient capacity to handle the heaviest work that comes in the shop.

But in the yard or storage shed, where large castings are kept to await their turn in the shop, it is a different problem. True it is convenient to have a huge crane or gantry, that can pick up any casting and deposit it just where you wish or transfer it to the shop cranes, but when the pieces run up to fifty and one hundred tons, it means quite an investment and cost of upkeep, and in such cases, the use is very spasmodic.

In a plant handling some of the heaviest castings made in this country, there is no crane in the yard for any purpose. Every casting, and they run up over one hundred tons in weight, is handled by a system of blocking, by the use of special though inexpensive track rollers and jacks.

Any piece can be put into the shop in a comparatively short time, without danger of tipping over, of the chain breaking or other disastrous results. True, there is always danger in handling heavy pieces but a crane is by no means a safeguard against it.

While comparatively little attention has been paid to developing this method of handling heavy castings without cranes there are plants where splendid object lessons can be obtained. Each plant presents its own problems which should be solved so as to include both safety and economy, although they are really one and the same thing.

Caution

Advices have been received from Burton Fils, of Paris, France, representatives of large American manufacturers, to the effect that someone unknown to them has falsely been introducing himself in this country as one of their firm. The gentleman in question is simply one of those "bunco" fellows to whom we have often referred in the past.

Warning to Automobile Makers

The enormous demand for automobiles has caused the manufacturers this year to exert every energy possible to turn out cars enough to supply this demand. It has also caused many new firms to be organized for the purpose of manufacturing motor cars, assembling them from parts and for the manufacture of parts. Many old firms in other lines of business have also established departments for the manufacture of automobiles or parts.

The automobile being a passenger-carrying machine, great care should be exercised in the selection of material for its different parts, and in the work put on these parts after selection, as the life and limbs of the passengers are in jeopardy when any of these important parts fail.

An instance of this that came under our observation recently was the breaking of a steering knuckle that caused the car to turn turtle in a ditch, as the driver had no control over the steering mechanism. Luckily, none of the four passengers were injured, but we frequently read in the papers of similar accidents that have caused the loss of life. This particular steering knuckle was made of a high grade of steel, and when broken it showed that only a small area of the section broken held the piece together just before the final break. The balance of the fracture showed that it had been gradually cracking toward the center for some time, due to the vibrational strains to which the metal was subjected. This clearly indicated that even though the piece were made of a metal specially suited to withstand the strain placed upon it, it was not hardened and tempered properly. If properly heat treated, this piece would have had as long a life as any of the other parts in the car.

The above condition of affairs would appear to make it seem timely to sound a note of warning to the automobile and part manufacturers against too much rush in manufacturing and assembling cars, and also to the public about buying cars from irresponsible firms who do not take the time to properly heat treat the materials that enter into the vital parts of a motor car, to select materials suitable for the work that they have to perform and to assemble the different parts in such a manner that they will not work loose.

The automobile industry has arrived at a stage where the best material and the treatment it should receive for a given part are well known, and if these are neglected, it can be blamed almost entirely on the rush to fill orders and the consequent carelessness on the part of manufacturers and part makers.

The cheapening of the automobiles may also have a tendency toward carelessness in the making of them, but if the manufacturers will see to it that the vital parts are made of the proper materials, and these materials properly heat treated and worked, the present demand will continue and increase as the years go on; but if poor materials are used, and these materials not properly worked, the business may receive a blow from which it would be very difficult to recover, and it might even never entirely recover in the manufacture of vehicles for pleasure.

Eli Emory Hendrick

Eli Emory Hendrick, president of the Carbondale Machine Company, Carbondale, Penn., died October 25. Mr. Hendrick has been at the head of his concern for a number of years, and the news of his death will be received with deep sorrow by the large circle of his friends and acquaintances.

Personals*

W. F. Evans, who has been connected with the Westinghouse Machine Company, has become manager of works of the Metal Products Company, Detroit, Mich.

R. H. Victory, of the Lowell machine shop, severs his connection with that company to take a position as assistant superintendent of the Eastern Bolt and Nut Company, Providence, R. I.

Ernest J. Berg, for the past 17 years associated with the General Electric Company, has been appointed professor of electrical engineering, in charge of the department, at the University of Illinois.

Wilhelm Clemens, Jr., of the firm of Schmidt & Clemens, Frankfort, Germany, is in this country on a few weeks' business trip. Mr. Clemens' address while in this country is Hotel Astor, New York City.

Richard A. Smart, who has been assistant manager of works of the Westinghouse Electric and Manufacturing Company, has recently accepted the position of works manager of the Oliver Chilled Plow Works, South Bend, Ind.

H. D. Penney, recently tool designer with the Overland Automobile Company, Toledo, Ohio, has accepted a position in the tool designing department of the National Cash Register Company, making the design of tool and fixture work a specialty.

H. L. Barton, works manager of the Westinghouse Machine Company, has resigned his position in order to join a new concern in Detroit for the manufacture of automobile parts. Mr. Barton's new company, of which he is vice-president, is to be called the Metal Products Company, and is expected to be in operation early in the spring.

*Items for this column are solicited.

New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make it Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

A Turbine Dynamometer

In these days of building automobiles by the trainload, the testing of the engines becomes an important feature and the dynamometer shown has been designed to afford a convenient method of doing this and showing the power developed at various speeds.

The shaft shown carries a disk with radial buckets cast on each side and forming the rotor of a double turbine. This revolves between the side plates shown which have similar brackets that face those on the disk. In the spaces between the buckets of the side plates are small openings through which water is admitted into the buckets on each side under control of gate valves at each end, operated by the geared shafts shown. These gates control the flow of water through the turbine brake and regulate the amount of work that can be absorbed by it.

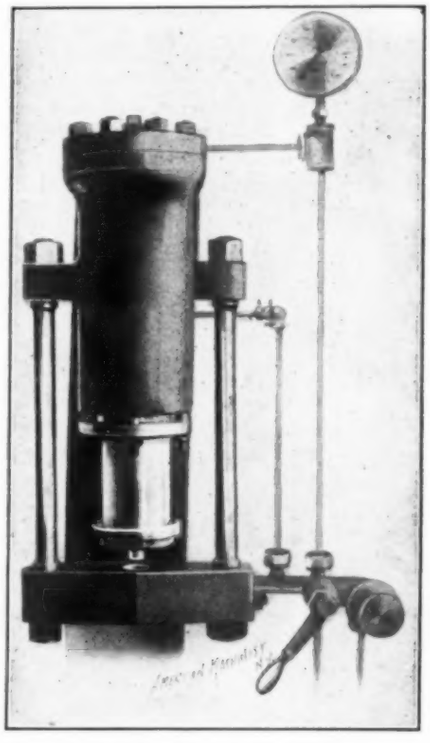
The saddle or frame is made to fit the same testing stand that the engine goes on and is driven by a universal coupling on the end of the square shaft.

A spring balance is hooked into the clevis at the right and connected to the floor while the balance is maintained by the weight at the left. Just enough water is passed through to keep the brake cool and the load can be kept constant with little attention on the part of the tester.

The device is built by the Herschell-Spillman Company, N. Tonawanda, N. Y.

A Hydraulic Press and Subpress

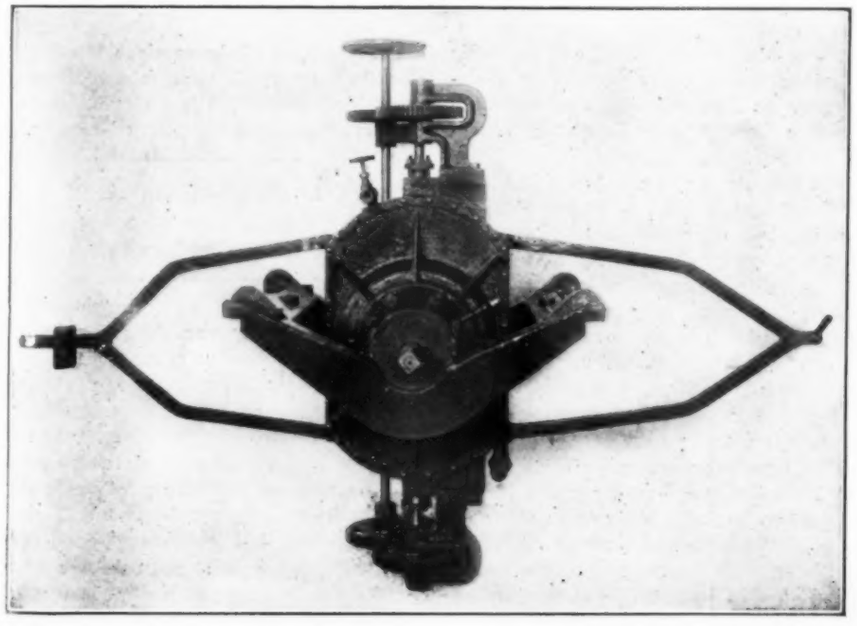
The press shown in the halftone was designed and built by the Charles Burroughs Company, Newark, N. J., for the manufacture of tantalum lamp filaments. The cylinder is 5½ inches diameter and the ram below the piston is 4½ inches diameter. The water under pressure is admitted both above and below the piston, and acting on both sides of the piston results in a steady downward stroke (free from jerks and irregularities), owing to the difference in area between the full face of the piston on top and the annular space below. A ½-inch cylinder and piston 2½ inches long is filled with the tantalum composition and placed below the main ram. In the end of this subpress cylinder is a diamond die with a 0.001-inch hole in it. The ram forces the tantalum out through the die in the shape of a filament about 0.002 inch diameter, as it expands slightly after leaving the die. The operator moves a card about below the die so that the filament falls on it in a series of curves. These are then cut in two, making horseshoe-shaped pieces, which are dried. The ½x2½-inch cylinder of material takes about 5 hours to pass through the 0.001-inch hole in the diamond die.



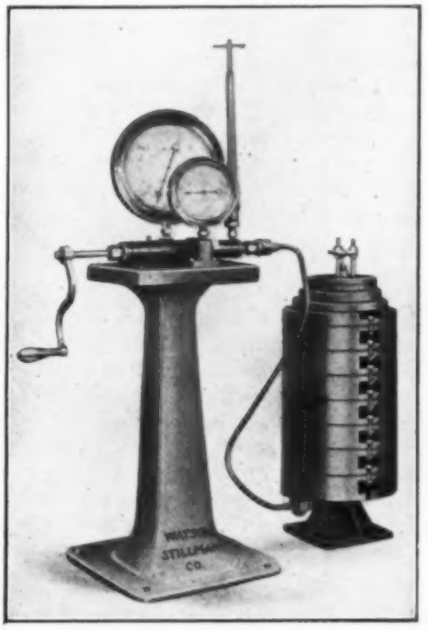
A HYDRAULIC PRESS AND SUBPRESS

Calibrating Apparatus for Hydraulic and Other High Pressure Gages

The bursting of machine parts and fittings from excessive fluid pressure is



TURBINE DYNAMOMETER FOR TESTING AUTOMOBILE ENGINES



CALIBRATING APPARATUS

usually accompanied by considerable danger, expense and delays for repairs. This is especially true with the extremely high working pressures under which liquids and air are often used. It is, therefore, quite important to know the pressure conditions within any apparatus using these sources of power, and for this reason the gages should be calibrated at regular intervals. Under the higher hydraulic pressures it is frequently the case that the same gage will show different percentages of error at different pressure readings, and these can be compensated for in ascertaining the true pressure only by comparing with a "master" gage of known accuracy or by loading with a known pressure.

The outfit illustrated herewith performs these two functions of testing by comparison with a master gage and of testing the accuracy of the master.

For the first, only the part on top of the stand is required. This consists primarily of a cross made of hydraulic bronze. The gage being tested, which may register any pressures up to 16,000 pounds per square inch, and the master, are attached to the front and back ends of the cross, respectively. At the left is a crank-operated screw displacement piston, by means of which the desired pressure may be produced within the pressure chamber. A suitable stuffing box prevents leakage past the piston. To the right end is connected a stop valve and filling cylinder. This permits (1) some of the liquid to be withdrawn from the pressure chamber before removing the gage being tested and (2) filling after a gage is put on. There is thus no danger of spilling the oil.

For testing the master gage, the special weight-loaded hardened and ground steel piston and cylinder are attached at the right by means of flexible copper tubing, as shown. These parts are cut out by a stop valve when not testing the master. The cylinder is long enough to have the center of gravity of the weight below the center of support. When the weights are revolved the friction due to lifting the weights is practically eliminated. The apparatus is made by the Watson-Stillman Company, of New York.

Multiple Stops for the Engine Lathe

The illustrations show the details of the multiple stops used by the Lodge & Shipley Machine Tool Company, Cincinnati, O., on their 16-inch patent head lathe. For duplicate-part work, where rapidity and accuracy are essential, these stops enable the operator to reproduce any number of parts without stopping to caliper diameters or measure distances between shoulders after once making the proper setting for the first piece. Five stops are regularly furnished, so that any number of diameters up to five, and any desired length for each diameter may be quickly turned on a single piece.

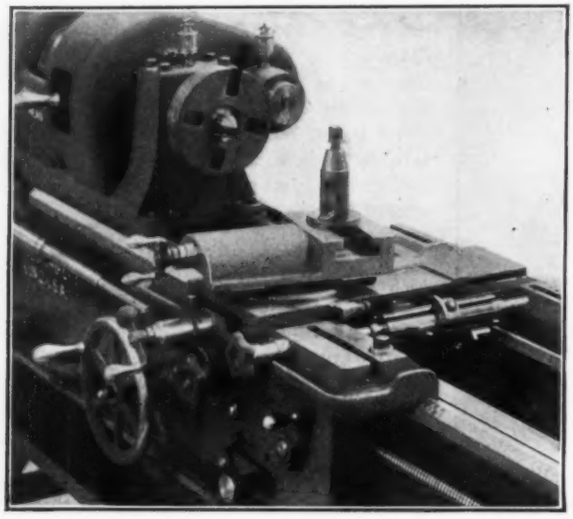


FIG. 1. DIAMETER STOPS ON CARRIAGE

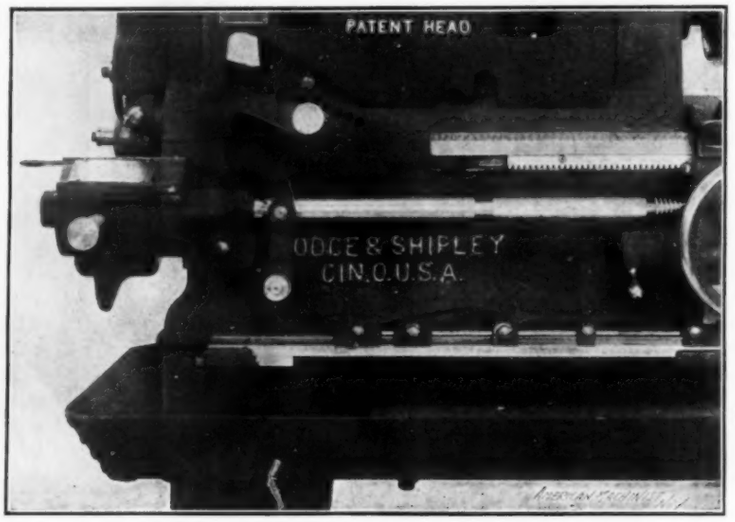


FIG. 2. LONGITUDINAL STOPS

The diameter stops are shown in Fig. 1. These are carried in T-slots milled in the rotating bar which is parallel with the bridge of the carriage. Each stop can be set to any desired position in its slot, and the entire bar is easily rotated by means of the star knob at the front of the apron, thus bringing the different stops successively into position, where they will be engaged by the lug on the cross-slide, as the tool is fed up to the cut.

The longitudinal stops are adjustable along the dovetailed upper sliding surface of the stop bar, which is carried along the front of the lathe bed, beneath the apron, as illustrated in Fig. 2, which shows a detailed view of that portion of the mechanism beneath the headstock.

The lead screw is divided beneath the headstock, and there driven through a jaw clutch, clearly shown in Fig. 2. The left half of the clutch is fixed and the right half is movable against a spring contained in the sleeve fitted over that portion of the lead screw. When the carriage feeds up to one of these length stops, the forward movement of the stop bar disengages the clutch at the lead screw, thus throwing out the feed. As soon as the latch at the lower left-hand corner of the apron is raised by the operator, the spring throws the jaw clutch and the stop bar back to their original positions, thus reëngaging the feed. The longitudinal feed then remains in until thrown out by the next stop.

The stops are so arranged that they can be set telescoping when required, so that even the shortest shoulder lengths can be obtained. They do not depend for their accuracy upon the tripping of a clutch. After the length feed is thrown out automatically, the operator, by about 0.003 inch hand movement of the carriage brings the stop bar up against an absolute stop, shown just below the jaw clutch, so that different lengths are duplicated exactly.

A Drafting Room Kink

By Claude Pitts

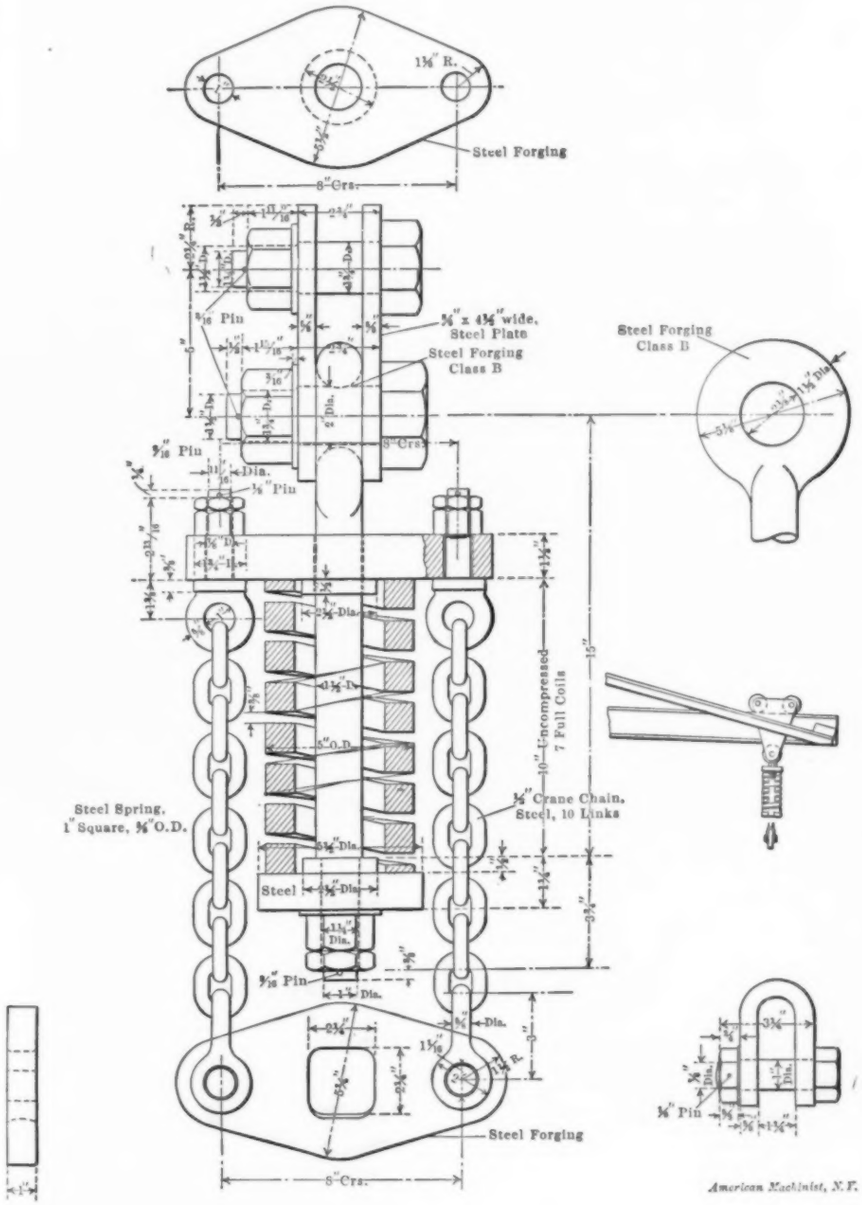
Described below is a drawing-room "kink," which may be an old one, although it might be of benefit to someone if you care to publish it.

In making up part lists covering drawing and pattern numbers from which a machine is built, tracing cloth is used. The form is ruled on the glossy side and the lettering, etc., put on the dull side. This method has two very good advantages; first it helps to make the tracing lie flat and second, if any changes or erasures are to be made it can be done without erasing the lines of the form.

A Flexible Crane Hook

By W. B. Beebe

The line cuts show a flexible crane hook. The jib crane located above the steam hammer in a shop where heavy forgings were made, was continually working loose and threatened some time to drop. This was due to the hammer being allowed to descend when the forging was not level on the hammer block, thus producing a terrible strain on the rigid structure of the crane. I suggested a flexible hook which was located as shown. After testing two or three springs we finally located a suitable one and found that the trouble was entirely eliminated.



AN ELASTIC CRANE HOOK

Treasury Department Definition of "Melting"

The collector of customs for the port of Philadelphia, in response to many letters received by him, has written to the Treasury Department requesting an interpretation of the term "melting" as appearing in paragraph 118 of the Tariff Act of August 5, 1909, which paragraph imposes a duty of $1 per ton on wrought and cast-scrap iron and scrap steel, and provides that "Nothing shall be deemed scrap iron or scrap steel except waste or refuse iron or steel fit only to be re-manufactured by melting."

The department advises that scrap iron and scrap steel which may be re-manufactured by being subjected to intense heat and then wrought or hammered to the size and shape desired is not scrap iron or steel within the meaning of the paragraph for the reason that, in the opinion of the department, the term "melting" as used in this paragraph is used in its ordinary acceptance, that is, to become liquid through heat and, therefore, no scrap iron or scrap steel is entitled to classification under paragraph 118 unless in its condition as imported it is unfit for use until it has been reduced from a solid to a fluid state by means of heat.

Cutting Gears without Proper Index Plates

By John Bailey

Recently, many articles have appeared on this subject, and in most of the articles quite a few extra tools were used. In our case we had to cut one gear with eighty-one teeth and could not accomplish it with differential gearing. Our method follows:

The crank of the dividing head revolved forty times to one of the spindle. For twenty-seven teeth, this meant 40/27 revolutions or one revolution and thirteen spaces. We sharpened an eight-H pencil so that the wood part would just fit into the holes in the dividing plate and gave the lead a very sharp needle point. We next laid the twenty-seven plate on a piece of drawing paper and scribed the outline and the hole in the center. We then marked through one hole and one thirteen spaces in advance. Removing the plate we now had a paper dividing head for the first and second teeth of a twenty-seven tooth gear, or the first and fourth teeth for the eighty-one tooth gear which we wanted. With the dividers we divided this space into three parts and we had our paper dividing head for the first four teeth of our gear.

We mounted the paper plate on the twenty-seven tooth plate with a little paste and cut one tooth to about half the required depth, feeding very slowly and holding the dividing head crank in position. We cut the two next teeth to half depth in the same manner and then tore off the paper and used the twenty-seven tooth plate. Setting the head to one of the teeth cut we cut full twenty-seven teeth around and then reset the head to the next tooth and cut around again. One more trip around finished the gear.

The actual time consumed was something less than an hour more than the job would have taken with a regular plate. I can hear some of the regulars remarking, "Gee, that must have been a bum gear;" but as a matter of fact this gear was used in a gear-feed box and ran as smoothly as any in the box.

An Interesting Experiment in Burglary

There wasn't anything really burglarious about it, for both secrecy and dark lanterns were missing, but all the rest of the outfit was on hand, including the safe, the burglars and a liberal supply of nitro-glycerin. The Ely-Norris Safe Company had a notion that their safe was really burglarproof, so they turned one over to the Robert W. Hunt Company and told them to get into it if they could in any old way that a burglar could use—and then a little more.

The burglars were Messrs. Oppenheim and Goe, of the Marietta Torpedo Company, Marietta, O., and the place was Perth Amboy, N. J., with an audience composed of bankers, insurance men and ye humble scribe of the AMERICAN MACHINIST. The torpedo experts in question are not of the submarine type, who invent ways and means to blow the other fellow's battleship into kingdom come, but of the less picturesque and more useful occupation of coaxing mother earth to give up her treasures in the shape of oil and gas, using as a coaxer a torpedo containing 250 to 350 pounds of nitro-glycerin exploded a few thousand feet, more or less, below the earth's surface. In addition to this they are recognized experts in safe blowing, being called in the most prominent tests.

Stripping the safe of all the outer trimmings the first move was to make a dent in the manganese surface across the joint where the door fits the body. This took about five minutes of husky swinging of a 12-pound sledge on a hot chisel and resulted in a furrow perhaps 1½ inches long, 3/16 inch wide and ⅛ inch deep. Then the burglars commenced to burgle in earnest.

A cup of red clay was made under the dent and ⅛ ounce of nitro-glycerin poured in so as to run into the depression. This was exploded in the regular way with a battery and a fulminate cap but only discolored the metal.

This was repeated with true burglarious persistency increasing the dose to ¼ ounce until the joint was stretched a trifle and more of an opening made, perhaps a couple of thousandths so the nitro-

FIG. 3. BEFORE THE 14TH SHOT OF 10 OUNCES

FIG. 4. AFTER THE 15TH SHOT OF 17 TO 20 OUNCES

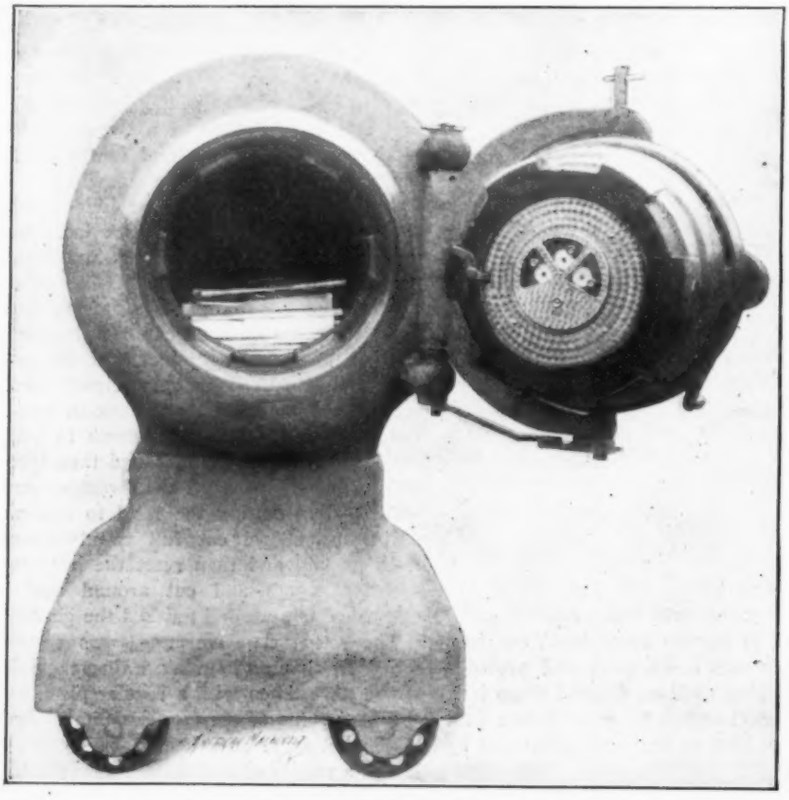


FIG. 1. BEFORE CLOSING FOR THE ATTACK

FIG. 2. BEFORE THE FIFTH SHOT

glycerin could run in. Finally at the seventh trial two clay cups were used with ¼ ounce of the coaxer in each, which was increased to ¾ ounce in each cup at the 11th explosion.

By this time the outer door was stretched so as to make it easy to introduce the explosive, and 8½ ounces were used up in the next two charges, when a 10-ounce charge was introduced, and there were things doing that reminded one of battleship target practice. Even this only bulged the door about ¾ inch, and then came the 15th and final charge of between 17 and 20 ounces, and then most of the outer portion of the door took a dive into the Arthur Kill, while the safe turned over and lay down to rest. But the contents were still protected by 3 inches of manganese steel, wedged in so tight that nothing could budge it.

Altogether over 40 ounces of nitroglycerin were used, four times as much as any burglar would dare use even if he had all the time he wanted, and the valuable contents, consisting of a dozen copies of the AMERICAN MACHINIST, were still safe against despoilation.

There is a feeling in some quarters that no safe can stand the action of an autogenous torch or blow pipe in view of the remarkable examples we have seen of their cutting of plates. But in all of these it is necessary to start from the edge or corner, and these safes do not present any starting points. An expert of one of the large makers of this apparatus assures me that it would be practically impossible to burn a hole into them as the flame would blow back and melt the nozzle. And it would be difficult for a burglar to use any of them, even assuming that they could cut a hole large enough to remove the contents, on account of destroying the contents of the safe or vault.

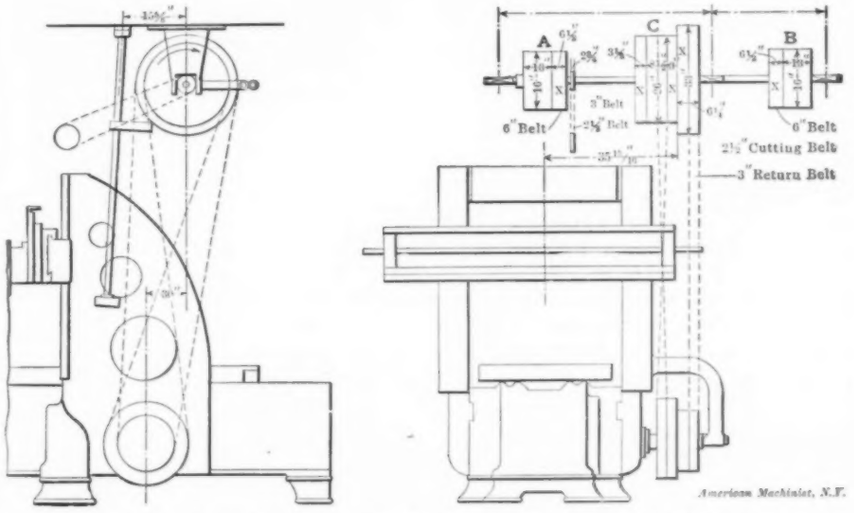
Altogether it was a very interesting exhibition, and, in spite of the large and nonburglarious charges used, the safe can be said to have withstood all attacks and preserved its contents against destruction or loss.

F. H. C.

A Three Speed Planer Drive

There is a general tendency toward two or more speeds for planers, and the accompanying illustration shows an interesting three-speed drive supplied by the Cincinnati Planer Company to the Heald Grinding Company, and which is giving very satisfactory results.

The countershaft is shown in outline over the planer, and while longer than usual and carrying eight pulleys, is not in the least complicated, and is very highly spoken of by all who have anything to do with it. Pulleys *A* are driven 470, *B* at 325, and *C* at 215 revolutions per minute from the line shaft by suitable pulleys.



A THREE-SPEED PLANER DRIVE THAT GIVES ENTIRE SATISFACTION

All the pulleys marked *X* are tight on the countershaft, while the three wider-face pulleys are idlers.

With the belt shifted so that the tight pulley of group *A* drives we have a cutting speed of 52 feet per minute and a return speed of 86 feet. Driving from *B* gives a cutting speed of 36 feet and a return speed of 60 feet, while driving from *C* reduces the cutting speed to 24 feet, and gives a choice of returning at 60 feet, or at 86 feet as may be deemed best, depending on the weight of the piece being planed. This because it often seems more desirable to return at a slower speed with a heavy piece, especially on short cuts, such as spotting of pads.

All these are controlled by two belt-shifters, one for *A* and *B*, of the regular type, and a belt shifter controlled by a rod coming down from the ceiling beside the right-hand housing of the planer for controlling the position of the belt on *C*. This is done by only taking the forward motion from the pulley *C*, taking the reverse from either *A* or *B* in all cases.

The explanation sounds much more complicated than the device itself, and it is so convenient that the operator changes these very frequently to accommodate the different kind of work designed. Roughing cuts are made at 52 feet per minute for the most part, although there are places where it is thought best to use the medium speed. On the other hand, most finishing cuts are made at the 24-foot speed, although the speed of 36 feet per minute is found slow enough in some cases.

Mr. Heald is particularly pleased with the device, especially on account of all the mechanism being away from the planer itself. He had even removed a motor from the housings of a larger planer on account of the very slight vibration being transmitted throughout the machine and he believes that for the best work the housings should be free of all driving mechanism.

Among the Shops

BY JOHN R. GODFREY

One of the finest things an apprentice learns is to lift his file on the back stroke to prevent ruining the points of the teeth and the same line of reasoning has usually been applied to hack saws, either hand or power driven. This has long been a strong talking point in many cases, and some of the saws actually lift away from the work while others make a bluff at it and never get very far. But——

I saw the other day a gang of hack saws cutting up high-speed steel for milling cutters and revolving the stock slowly to insure an even thickness for the blank. These did not lift on the back stroke, and *there was as big a pile of chips on the one side of the bar as the other.*

At first we thought it was simply due to chips that stuck to the front of the teeth on the forward cut being knocked out as it came back, but couldn't hold this responsible after a careful examination of the saw blades at close range. The only explanation seemed to be that the saw actually cut on the back stroke at the time we usually suppose it is engaged in knocking off the cutting edge and fast approaching the general debility stage. If this is so, and it surely looked so in this case, perhaps our notion of raising the saw isn't as brilliant as we had thought it.

The maker of these cutters told me that fully 90 per cent. of the orders for cutters were now for high-speed steel, and that he was seriously considering making carbon-steel cutters only on special order. Such are the changes of a few years.

THE COST OF ACCIDENTS

The problems of accidents, either in or

out of the shop, are always with us, and they mean more than looking sorry, or even chipping in to buy a wooden leg, or flowers for the funeral. Without meaning to be heartless in the least, we can say that the accident which cripples a man so he is unable to earn his living or support his family, is worse than when it is fatal, so far as the question of finances are concerned. True, many crippled men are bright and sunny, giving comfort to their loved ones, but that does not affect the question of providing a house, food and clothes.

Every accident which takes a good man out of the shop for even a day, costs the employer more money than he realizes, especially in good times when work is rushing, and means much when good men are scarce as at present.

In one shop I know of, where many gears are guarded, a good man went to work on a lathe with unguarded back gears. He had been used to a lathe that was fully protected, and in less than half an hour the end of one finger had been claimed by the demon of the unguarded gears.

Careless, you say? You and I always worked with unguarded gears and never got caught? Gears were almost never guarded in the old shops, yet who can say the number of accidents were few on account of care or just luck? And if we think a little, many of us can remember cases where a finger, or even the cherished flowing beard of a patriarch went the way of the gears.

The manager of this shop didn't even call it careless. The man went to the doctor, lost a little time (but not wages), and there isn't an unguarded gear in the shop today that he knows of, even of the smallest lathe. The money that little accident cost in cash, to say nothing of lost time, would have guarded everything but the moral law.

A funny side of the case is that the factory inspector ordered the covering of gears at the top of drill presses, but never mentioned the back gears of the lathes that caused the damage. All of which goes to show that we cannot rest content with doing what we are told, but must look out for things ourselves, to do our whole duty to the men or to ourselves.

Probably the manager in question could have crawled behind the defense of compliance with all requests of the factory inspector and thrown all the burden on the workman. But he wasn't built along those lines, and I'm glad to say I know a number of the same kind.

Accident Insurance

Along this same line I want to unburden my system on the question of accident insurance, which seems to be coming in the near future if we read the signs anywhere near right. The present system of insuring against damage suits has many points that do not look as attractive as they might to right-thinking men when the actual practices in too many cases are brought to light. The adjuster has to have a heart of the Pharo brand, and many of them revolt at the way in which injured men or widows are browbeaten into accepting a pitifully small sum.

The way out is probably an accident insurance *for* the men, not against them as at present, the premium paid to be charged to overhead or shop expense the same as fire and other insurance, and the amount added to the price of the goods if necessary.

It might be impossible for many small manufacturers to pay the cost of all accidents just as it would put them out of business if a fire occurred when they carried their own insurance, but they could pay the premiums, and I believe this will be one of the ways out. The average employer is just as humane as anyone else, and the present system puts him in a false light which I believe he will gladly get out of when opportunity offers.

And the man who refuses to use a safety appliance on account of being nifty about his skill is a fit candidate for some other job.

Automobile Gears Again

The question of gears for automobiles will not down. Only recently a well known maker admitted all kinds of trouble from an alloy steel due to distortion in heat treating. This is so great that the gears change their pitch diameter enough to play hob with quiet running. To avoid this they are going to experiment with another alloy that is said to run well without hardening.

One concern is now finishing the gears after heat treatment by taking a shaving cut insuring that no distortion exists when they go into the car. This is somewhat expensive, as while the gears can be cut, they are pretty hard, and the process of recutting is rather slow as well as being hard on cutters.

Then there is the process of grinding the teeth after heat treatment, which is very limited as yet, and is not well enough known to say just where it stands.

Some find a solution in running oil and emery or other abrasive in the gear box for awhile, but it sort of goes against the grain to think of it. It may be an old-fashioned notion, but it seems as though it must exaggerate any existing defects in the tooth shapes and I cannot get away from the idea that some of the abrasive is bound to be left in the surfaces, converting them into a lap which will keep up the grinding process indefinitely.

A friend, who is also an old-timer and a good hardener, claims that much of the trouble is due to improper annealing when the gears are made. He insists that if the blanks are first roughed out, then annealed thoroughly by careful heating and cooling away from the air, much of the the trouble in warping or changing size or shape in any way will be avoided.

Of course, the time taken seems considerable, especially in view of the fact that we buy the stock in a supposedly annealed state, but if it will do the trick, it is certainly cheaper than the operations and cuss words we now indulge in to make them usable after they are heat treated.

A Few Types of Silent Pawls

By Ralph W. Davis

In working up a feed device for some special machinery, I found it necessary to use a pawl and ratchet, the pawl being the driving member. As the speed was high, it was evident that the noise of an ordinary arrangement would be objectionable and a silent pawl became desirable.

In a search for available literature for an efficient device of this character, I found that there was but little published, the only one of value being that described by Professor Sweet, on page 495 of Vol. 31, Part 2. In the accompanying sketches I have shown two other successful devices that I know of and one of my own.

Fig. 1 illustrates the principle of a device used with the brake mechanism on heavy cranes and hoists in steel mills. The driving member A is shown rotating in the direction R, thus driving the ratchet B by means of the pawl P. When A reverses and moves in the direction L, the pawl is raised until it meets the stop pin F, which motion is caused by the change in position of the links D and E. The locked linkage now causes the spring clamp G to move with it, while the resistance due to its spring tension keeps the pawl raised above the ratchet teeth as long as rotation in that direction is continued. When A again begins to move in the direction R, the pawl instantly drops, as clamp G remains stationary during the change in position of links D and E.

Fig. 2 shows an effective device used on some electrical apparatus; the absence of ratchet teeth will be noted. When the driving member A rotates in the direction R, the pawl P is free and is held lightly against A by the small spring C. On the reversal of A the pawl tends to rise as its end surface is roughened and grips firmly on the inner surface on A. The harder the pull the more it will grip as pawl P attempts to assume a vertical position.

Fig. 3 is a device of my own arranging. As shown, the driver A is rotating in the direction L, the pawl P is driven by A, through the contact of E at X, the pin B having merely moved the pawl about its axis D at the beginning of motion. The pin D, which carries the pawl, is itself carried by the sliding block E and the extended end of D also passes through an arm of the casting G, which latter is an easy fit on the shaft. When A begins

to rotate in the direction *R*, the block *E* remains stationary, while the pin *C* advances against the projecting finger on the pawl *P*, causing it to rotate about *D*, thus bringing the point above the ratchet teeth. At this instant face *H* of sliding block *E* comes against the face *Y*, which rotates all the parts except the ratchet as far as the stroke is set, the reversal at the end of the stroke again bringing the pawl into engagement, and driving the ratchet.

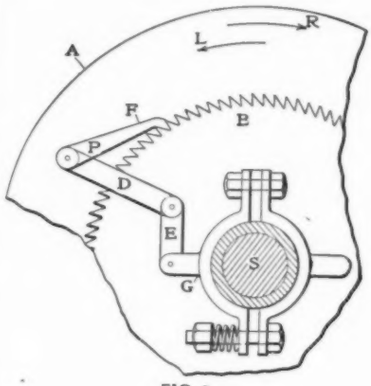


FIG. 1

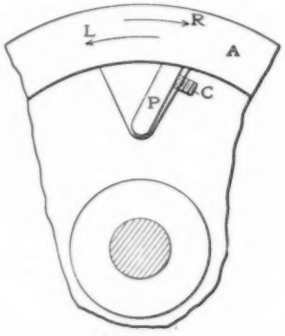


FIG. 2

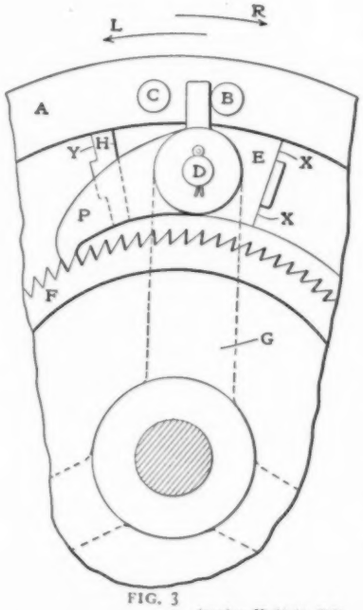


FIG. 3

American Machinist, N.Y.

SILENT PAWLS

Forthcoming Meetings

National Gas and Gasolene Engine Trades Association, Chicago, November 30, December 1 and 2. La Salle hotel. Albert Stritmatter, secretary, Cincinnati, O.

National Society for the Promotion of Industrial Education, annual convention, December 1, 2 and 3, Milwaukee, Wis. J. C. Mcnaghan, secretary, 20 West Forty-fourth street, New York City.

American Society of Mechanical Engineers, annual meeting, New York City, December 7-10. Calvin W. Rice, secretary, United Engineering building, New York City.

American Society of Agricultural Engineers, third annual meeting, December 28-29, 1909, Ames, Ohio. F. W. Chase, secretary, University of Nebraska, Lincoln, Neb.

Business Items

John A. Roebling's Sons Company, of Trenton, N. J., has placed with Tate, Jones & Co., Inc., an order for the entire oil-burning equipment for its six 30-ton, open-hearth steel-melting furnaces.

Cole & Staiger, dealers in hardware, tools and machinists' supplies, 59 Centre street, New York, are, upon request in writing, giving out a keyring to which is attached an aluminum tag stamped with a serial number, their address and the intimation that 50c. reward will be paid for its return to them. The serial number and applicant's address are filed in their office.

Business Opportunities

Warner Bros., will erect a sawmill at Foley, Minn.

C. N. Parker is to erect a foundry at Brainerd, Minn.

The West Duluth (Minn.) Auto Club will erect a garage.

The Coventry Mill, Anthony, R. I., is building an addition.

Lewis Inbody, Waco, Neb., will rebuild his blacksmith shop.

The Fremont (Neb.) Foundry Company will erect another plant.

The Allendale (R. I.) Worsted Company is building an addition.

Byron Reed Company, Omaha, Neb., will erect a $10,000 garage.

The McIntyre Watch Company, Kankakee, Ill., will erect a factory.

Max Bruckner and others will erect a flour mill at Platte Centre, Neb.

Brodin & Malen will erect a sash and door factory at White Rock, S. D.

The Millersburg (Ohio) Furnace Company will move its plant to Canton.

The Kendall Knitting Company, Utica, N. Y., will erect a new plant.

The Monadnock Mills, Claremont, N. H., will install a new power plant.

The Vanderbeek Tool Company, Hartford, Conn., will erect a new plant.

The Armstrong Woolen Company, Detroit, Mich., will erect a new factory.

The Loughman Cabinet Company, St. Louis, Mo., will erect a $40,000 plant.

The Vulcan Iron Works, New Britain, Conn., will erect another foundry.

Fire destroyed the plant of the American Fiber Company, Jacksonville, Fla.

The Detroit (Mich.) Pressed Steel Company has secured site for a plant.

The plant of the Brundin Packing Company, Albert Lea, Minn., was burned.

The Majestic Range Company, St. Louis, Mo., will erect an addition to its plant.

The Clough-Hartley Company, Everett, Wash., is building a new shingle mill.

The Atlas Shear Company, Bridgeport, Conn., is erecting a two-story addition.

The Yoeman Body Box Company, Detroit, Mich., will erect a new $50,000 factory.

The Crosby Mining Company, Nashwauk, Minn., will erect a machine shop, etc.

J. L. Roberts is to erect a $100,000 steel plant on the tidelands, Tacoma, Wash.

The Badger Sash and Door Company, Milwaukee, Wis., is erecting an addition.

The Nairn Linoleum Company, Kearney, N. J., will build an addition to its plant.

The Badger Traveling Goods Company, Milwaukee, Wis., will erect a new factory.

The Jarden Lithographic Company, Philadelphia, Penn., will erect a new factory.

The Louisville (Ky.) Furniture Company has taken out a permit for a new factory.

Plans are ready for a new machine shop for the Windsor (Vt.) Machine Company.

The Standard Electric Company, Racine, Wis., is planning an addition to its plant.

The Harsh & Edmonds Shoe Company, Milwaukee, Wis., will erect a $40,000 factory.

Joseph and John Wolfinger will build a $30,000 woodenware factory at Eland, Wis.

The Consolidated Sheet Metal Company, Milwaukee, Wis., will erect a new factory.

The Tacoma (Wash.) Ornamental Iron and Wire Works will erect a structural steel mill.

The Michigan Central Railroad has plans for car shops to be erected at Bay City, Mich.

The Sobey Manufacturing Company, Seattle, Wash., will erect a sawmill at Ballard.

The Missouri Can Company, St. Louis, Mo., will erect a new factory to cost about $50,000.

D. O'Brien's machine shop, etc., at Brule, Wis., were destroyed by fire. Loss, $40,000.

The sawmill of J. R. Dana Company, at Phillips, Wis., was burned. Loss, $150,000.

The Kilhorn Photo Paper Company, Cedar Rapids, Iowa, will erect a four-story factory.

The Baird Machine Company, Oakville, Conn., has the plans ready for a new factory.

Dr. T. J. Martin will erect a plant at Muscatine, Iowa, for the manufacture of ice.

The Union Malleable Iron Company, East Moline, Ill., will erect an additional building.

The Bradley Knitting Company, Delavan, Wis., will erect a spinning plant and box factory.

R. S. King Company, Seattle, Wash., will erect a $200,000 slate factory at Othello, Wash.

The Seattle, Renton & Southern Railway will build repair shops at Columbia Station, Wash.

The United Mica Company, Grafton, N. H., will install a machine-shop equipment at its plant.

The Village Council, Aurora, Minn., will purchase a new boiler for its electric-light plant.

The Waterbury Chemical Company, Des Moines, Iowa, will enlarge and improve its plant.

The Peninsular Safe and Lock Company, Portland, Ore., has purchased site for a new plant.

The Traverse City (Mich.) Refrigerator Company has started the erection of a new plant.

Joseph Lomax, Philadelphia, Penn., rug manufacturer, is building an addition to its factory.

The plant of the Valley Machine Company, Underwood, Iowa, was burned. Loss, about $25,000.

The Standard Company, Torrington, Conn., manufacturing piano hardware, will erect an addition.

The Trepert Auto Gasoline Engine Company, Rochester, N. Y., will move to Columbia City, Ind.

The Union Steam Pump Company, Battle Creek, Mich., will erect a new two-story machine shop.

Fred E. Schuler & Bro. will build an auto factory at Milwaukee and Huron streets, Milwaukee, Wis.

The Coy Paper Company, West Claremont, N. H., is building an addition. Will install a new engine.

S. B. Sexton Stove and Manufacturing Company, Baltimore, Md., will build an addition to its plant.

The Sebastian Lathe Company, Covington, Ky., is contemplating the erection of an addition to its plant.

The Williams Manufacturing Company, Bridgewater, Mass., making shoe racks, will erect a new factory.

The Green Bay (Wis.) Paper and Fiber Company will build an addition, doubling the capacity of its plant.

The McElwain Shoe Company, Newport, N. H., is building an addition and will install a new boiler and motors.

The Wheelock Wire Company, of Worcester, Mass., will move to Clinton, Mass., where a new plant will be erected.

The Buffalo (N. Y.) Foundry and Machine Company has had plans prepared for the erection of a new machine shop.

Chas. H. Besly & Co., manufacturing machinists' tools and brass specialties, will extend its plant at Beloit, Wis.

The Packard Motor Car Company, Detroit, Mich., has taken out a permit to erect another factory to cost $65,000.

The Leighton Machine Company, Manchester, N. H., manufacturing knitting machines, will erect a new plant.

The Dairymen's Manufacturing Company, Jersey City, N. J., will build an addition to its plant, also new power house.

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper catalog free. E.G. Smith, Columbia, Pa.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Machines designed; automatic special. Practical working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emery & Co., Newark, N. J.

Have you small, complicated experimental work or tool designing others can't do? Send to Benj. O. Butler, Taunton, Mass.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

Metal specialties manufactured, models, dies and special machinery; inventions perfected. Villinger Mfg. Co., Williamsport, Pa.

Wanted—Purchaser for No. 2 Farwell milling machine, Grant hobbing machine and Gisholt tool grinder; all practically new and in A-1 condition. Box 755, AMER. MACHINIST.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Energetic toolmaker and machinist with ability to make up-to-date tools and machinery for the manufacture of brass globe and gate valves, desires position. Box 891, AM. M.

Graduate mechanical engineer, now employed, wishes position as assistant superintendent; several years' practical experience; successful handler of men; best references. Box 652, Stamford, Conn.

Experienced superintendent, now employed, open for engagement; large experience in manufacturing small or medium interchangeable work; good reliable mechanic with executive ability; thorough experience in modern shop methods. Box 904, AMER. MACH.

INDIANA

Wanted—Position as shop manager or special machine tool salesman; for past ten years have manufactured and sold turret lathes, boring mills and special tools and fixtures for reducing cost; I wish to change from present position about January 1 next. A. S. M. E., No. 2967, Box 903, AMER. MACH.

MASSACHUSETTS

Foreman toolmaker, at present employed, desires change. Box 872, AMER. MACHINIST.

NEW JERSEY

Mechanical engineer, experienced in power plant design and installation, manufacturer of condensers, pumps, piping. Box 860, AM. M.

College graduate, 31, with practical experience as machinist and foreman, tool designer, familiar with modern shop methods, wants to change; good references. Box 862, AM. MA.

Mechanical engineer and designer desires a position as designer or superintendent; ten years' practical experience in drafting room and shop; experienced in gas and oil engine work. Box 907, AMERICAN MACHINIST.

Salesman—Machine tool salesman as sales manager, having 15 years' experience, both in the manufacture and selling of machine tools; competent judge of condition and value of second-hand, and familiar with all makes in the United States; can give best of reference. Box 790, AMERICAN MACHINIST.

Accountant; young man wishes to change; 10 years' experience in iron, steel and machinery lines; familiar with up-to-date system for cost keeping, stock keeping and inventory; experienced in handling office force; now acting as assistant to superintendent; also two years assistant to organizing engineer. Box 882, AMERICAN MACHINIST.

NEW YORK

Mechanical engineer and designer, seven years' practical experience in drafting room and shop; wants position offering a future; good references. "H. L.," Box 895, AM. MA.

Experienced machine designer desires position; technical man with six years' experience on general machine, railroad and gasolene engine work; also two years teaching machine design. Box 905, AMERICAN MACHINIST.

A first-class mechanic who has had charge of various departments in large factories and has traveled extensively for years as instructor to salesmen, wants position in sales department of New York house. Box 881, AM. M.

Production engineer of wide experience in developing earning power, factory analysis, rate setting, organization of departments, cost systems and discipline, wishes permanent position on contract, salary or percentage; location immaterial. Box 868, AMER. MACH.

Mechanical engineer wishes to correspond with first-class concern desirous of making such improvements in their shops as will increase production and reduce cost of maintenance; large experience along this line; open for engagement for shorter or longer period; moderate salary. Box 908, AMER. MACH.

Designing engineer of established reputation, extensive experience on special and intricate automatic machinery, presses and sheet metal working machinery, invites correspondence from progressive concerns wishing the services of a practical, capable and energetic man of highest standing. Box 909, AMERICAN MACHINIST.

Electrical engineer with highest references, wishes to form connection with good concern, preferably in or near New York; three years' experience in Mexico, five years in Chile; speaks Spanish and German fluently; has had wide experience, both in selling and constructing electrical, steam and hydraulic machinery; open for immediate engagement. Address "H. K. W.," AMERICAN MACHINIST.

OHIO

Mechanical engineer, experienced machine tool designer, wants change; charge of designing department or assistant superintendent preferred; college graduate; age 33; married; A-1 references. Box 906, AMER. MACHINIST.

PENNSYLVANIA

Designer, age 32, graduate mechanical engineer, 12 years' experience fine apparatus, typewriters, adding machines, tools, automatic machinery, especially expert on experimental development and design, desires position in charge of such, or as chief draftsman, leading designer, etc. Box 873, AM. MACH.

WISCONSIN

Mechanical and electrical engineer with 15 years' experience in engineering contracting and machinery manufacture, eight years in executive positions and at present filling responsible position, will consider suitable position with other concern. Box 884, AM. MA.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted—A draftsman for work on small rotary motors and pumps. Address Box 508, West Hartford, Conn.

Wanted—A first-class draftsman on tool and fixture work for automobile parts; steady employment to competent man; state age and experience in full. Box 880, AMER. MACH.

Wanted—Experienced mechanical draftsmen for detail work, in a concern manufacturing general rolling mill and hydraulic machinery; state age, experience and salary expected. Box 796, AMERICAN MACHINIST.

Wanted—In every machine trade center, a live man, with trade acquaintance, to sell a high-class and money-saving tool, already widely used and advertised; give age, experience and references. Box 888, AMER. MACH.

Salesman wanted, having had experience in selling to the mill supply and hardware trade, also manufacturers to represent us in our chain block department; give experience and references. Box 866, AMERICAN MACHINIST.

DELAWARE

Wanted—A man who is thoroughly familiar with case hardening and blueing; we have a good position for the right man in one of the finest firearms factories in the country. In reply, give age, experience and salary expected. Box 899, AMERICAN MACHINIST.

ILLINOIS

Wanted—A working foreman to take charge of cutter department; we have a permanent position for one who is thoroughly conversant with the manufacture of milling cutters. Box 892, AMERICAN MACHINIST.

Wanted—Diemaker for pressed steel work; must be thoroughly acquainted with construction of dies for drawing, piercing and forming; give experience, state wages; steady employment for right man. Box 893, AM. MA.

Foreman Wanted—With ability to successfully handle 20 to 30 toolmakers to act as assistant to present foreman; applicant must have experience on fine tool work and general manufacturing; state wages wanted and present position. Box 902, AMERICAN MACHINIST.

Foreman Wanted—To take charge of grinding department consisting of 15 plain and universal grinders; must be familiar with up-to-date grinding methods and capable of producing accurate work; only applicants considered who are holding similar positions; state wages wanted and references. Box 901, AMERICAN MACHINIST.

Capable executive to take entire charge of cost department including time keeping, cost records, expense distributions and stock keeping; must be capable of handling such records for factory employing 500 hands on small work similar to typewriters or adding machines; only applicants occupying similar positions and with first-class references will be considered; permanent position with excellent prospects; modern plant, up-to-date methods; state salary wanted. Box 900, AMERICAN MACHINIST.

MASSACHUSETTS

Wanted—An inspector of gears and gear cutting in a large jobbing shop; one who has had experience on this particular specialty preferred; state age, experience and wages expected. Boston Gear Works, Norfolk Downs, Mass.

Wanted—Capable executive to take charge of rate setters in engine works; must be experienced in determining piece rates, both directly and indirectly, from analytical time study observations; state age, experience and pay expected; correspondence confidential. Address "R. S. D.," P. O. Box 167, Boston, Mass.

Wanted—Electrical draftsmen and mechanical draftsmen; pay from $3.60 to $5.04 per diem; a competitive examination will be held at the Navy Yard, Boston, Mass., November 30, 1909, for the purpose of establishing an eligible register of electrical draftsmen and mechanical draftsmen. For application and further information address, "Commandant, Navy Yard, Boston, Mass."

MICHIGAN

Wanted—First-class man experienced in placing stock. Address Hudson Motor Car Co., Detroit, Mich.

Wanted at once, toolmakers, die sinkers, trimming diemakers, machinists, automatic screw machine hands; state age, experience, customary wages and references. Buick Motor Company, Flint, Mich.

Draftsman Wanted—One A-1 layout man, familiar with current practice in automobile design; a thoroughly reliable and accurate man is required and one who can turn out work in reasonable time; to such a man a good salary will be paid and opportunity offered for advancement; we have openings also for a careful checker and two detailers and two experienced tool and jig designers; only first-class men with mechanical experience wanted. Reliance Motor Truck Co., Owosso, Mich.

MISSOURI

Wanted — High-grade experienced emery wheel salesman to sell carborundum. W. R. Colcord Machinery Co., St. Louis, Mo.

Wanted—A-1 operator for Potter & Johnston semi-automatic machine; one who can make his own repairs; answer, giving experience and wages expected to Wagner Electric Mfg. Co., St. Louis, Mo.

NEW JERSEY

Wanted—Experienced draftsman familiar with automobile work; state age, experience and wages expected. Mercer Automobile Company, Trenton, N. J.

Man with A-1 experience and good address for position of traveling inspector among automobile concerns; good opportunity for right party. Write Inspection Dept., Box 476, Newark, N. J.

Mechanical Engineer Wanted—Must be graduate from prominent college; young man under 30 to act as assistant to manager in engineering business; first-class opportunity for bright, energetic, educated young man with good chance for advancement. Apply personally, between 10 and 12, Imperial Machine Co., Newark, N. J.

Foreman, for small manufacturing shop, running between 15 and 20 men, building a line of special machinery; the position is not an easy one as the work is varied and considerable of it built to order; shop equipment modern. In answering, give full particulars as to age, experience and reference. Box 850, AMERICAN MACHINIST.

NEW YORK

Wanted—One planer hand, also good millwright. Address P. O. Box 704, Matteawan, N. Y.

Wanted—Superintendent for general machine shop and foundry; salary $2000; state age, experience and former employment. Box No. 4A3, AMERICAN MACHINIST.

Wanted—Machine shop foreman for shop employing about fifty men; jobbing shop on heavy work; state experience, age and salary wanted. Box 887, AMERICAN MACHINIST.

Wanted—Western sales representative for well established eastern company manufacturing steam boilers, water pipe in all sizes; also engineering work. Box No. 3A5, AMER. MACH.

Machine molders wanted for brass foundry work; write giving experience and wages expected; nine hours, open shop, in small city; living expenses and rent low. Box 857, AM. M.

Wanted—A mechanical draftsman about 30 years old, married; familiar with mill work; steady job for right man; town of 6000 in New York State, having first-class schools. Box 886, AMERICAN MACHINIST.

We are looking for a young man thoroughly familiar with factory office routine; will use him partly on production and partly on repair orders in the automobile line; we also have vacancies for several draftsmen with automobile experience, factory office experience in addition would be desirable; state age, nationality, education, experience in detail and salary expected. Box 861, AM. MA.

OHIO

Wanted—First-class machinists; no labor troubles. The Heisler Co., St. Marys, O.

A gas-engine salesman; mechanical engineer to take charge of office. Box 896, AM. MACH.

Foreman machine shop, who is acquainted with piece work and managing of men. Box 897, AMERICAN MACHINIST.

Machinists wanted on machine tools and erecting floor; no labor troubles. Lima Locomotive and Machine Co., Lima, Ohio.

Wanted—Experienced draftsman for designing and detailing on sheet-metal working machinery; steady position offered. Box 870, AMERICAN MACHINIST.

Wanted—Manager who can obtain some capital, for modern machine works, running day and night, located in Ohio. "Engineers," Box 759, AMERICAN MACHINIST.

Wanted—Clerk for drafting room capable of making and keeping up bill of material and records of blueprints. Write, stating experience and salary to Box 878, AMER. MACH.

Wanted—First-class large lathe and planer operators; good wages and steady work for the right parties; location, medium size town in central part of Ohio. Box 834, AM. MACH.

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A Machine Shop without Cutting Tools

The Machines and Fixtures Used in Building Burglar Proof Safes out of Manganese Steel Which Can Only Be Machined by Grinding

EDITORIAL CORRESPONDENCE

Anyone who is familiar with the peculiar properties of manganese steel, which is practically speaking, a non-cuttable metal, will appreciate the difficulty of engaging in the manufacture of safes from this material. While it is true that manganese steel can be cut, the experiments conducted by a manufacturer in drilling this material will show that it is hardly a commercial proposition. He attempted drilling a ¾-inch hole in manganese steel and succeeded in reaching a depth of three inches at the end of thirty days, making it rather an expensive hole.

Through the courtesy of the Ely-Norris Safe Company, Perth Amboy, N. J., and their superintendent O. W. Bedell, who designed most of the tools, we are able to show the operation necessary in the manufacture of these safes, and it is hardly an exaggeration to call it a machine shop without cutting tools, the only exception being drilling a comparatively few holes in materials which are not manganese steel. Our grinding friends will, of course, take exception to this as they show us chips of ribbon and other shapes, proving that grinding wheels do cut, but we use the word "cutting" in its usual sense.

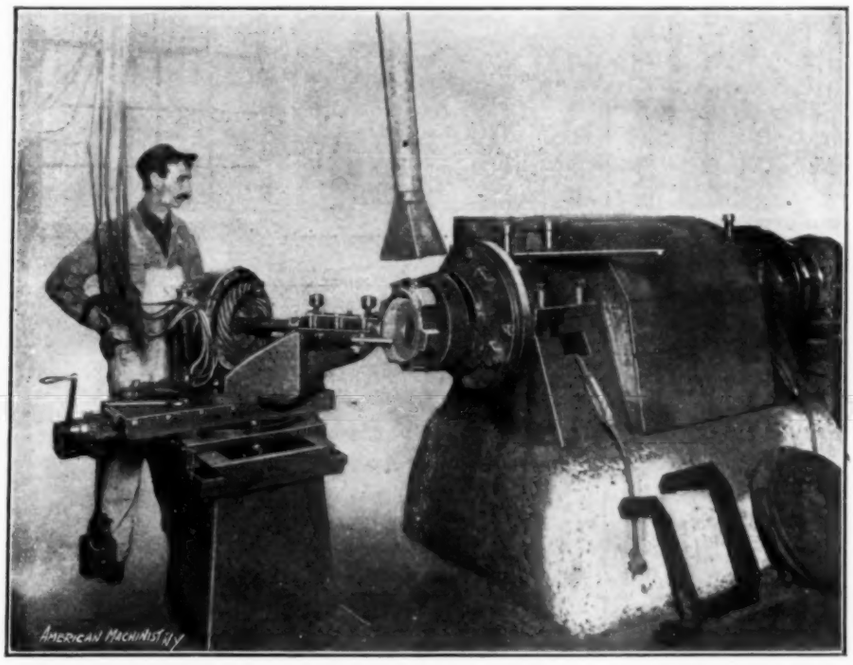

FIG. 1. GRINDING THE END OF THE DOOR

Starting with the door of a No. 150 safe, which is about 24½ inches outside diameter, and weighs about 800 pounds, we find it mounted in a very simple chuck as shown in Fig. 1 for the first operation of grinding the inside end of the door, and then the inside or recess which holds the time lock. Practically all the machinery used in this shop has been built especially for this work, and it will be noticed in most cases that a peculiar type of motor is used. These motors are for alternating current and are mounted direct on the grinding spindle, which is held in the special slide rest shown.

Grinding the Taper Fit

The next operation is grinding the outside diameter of the door to the correct size and taper. It will be noted that the front end of the door carries six lugs and on the inside of the safe body in Fig. 14, corresponding lugs can be found which engage those of the door. The contact surfaces of all of these lugs are backed off to a taper or angle of 0.01 inch to the inch, and while this seems slight, it is ample to secure an extremely rigid lock and draw the tapered door solidly into the body of the safe itself. These lugs, both in the body and on the door, are ground to this angle by a backing off device, which moves the grinding wheel in and out at the proper time to secure the desired result. Two of the gages used in measuring the door are shown leaning against the foundation of this grinding head and will be seen later in Fig. 13.

After the door has been ground on the end and the outside it goes to the drilling department, as shown in Fig. 2, where it is mounted in the jig shown under a Prentice radial drill. It must not be thought, however, that the apparently impossible feat of drilling manganese steel is about to be performed, for such is not the case.

The Wrought Iron Inserts

In making these safes it is absolutely necessary to drill and tap a number of holes, and in order to do this wrought-iron inserts are placed in the mold at every point where it is necessary to have a drilled hole. After the door is properly mounted in the jig, all of these holes can be drilled, as the drill only has to cut wrought iron. It is, of course, necessary to make these wrought-iron inserts somewhat larger than the holes to be drilled to allow for shifting in the mold, and also for a certain hardening effect, which comes from the manganese cast around them. The jig shown is all that is necessary in drilling all holes in the door, being located in four different positions by the index pin shown below the trunnion. The large hole being drilled is for one of the locking bolts which can be seen in Fig. 14.

Fig. 3 shows the drilling of the yoke in which the door swings by means of the trunnion ring shown in place in the jig at the right. This ring is fastened to the front of the door, the trunnion swinging in the yoke. The opening at the right carries the small pinion which revolves the door and engages the fixed cam, as can be seen in Fig. 14. The jig shown on the drill-press table is for the time lock on the inside of the front end of the door.

Large Master Plate Work

After the holes have been drilled, the door goes to the grinding machine shown in Fig. 4 to have the holes ground for the combination lock. This is, in reality, a very interesting application of master plate work on a large scale, as can be judged from the weight of the door. The door is located against stops in the movable eccentric, and as shown in the illustration, is grinding out the second hole. These must be of an exact diameter, and also correctly located with relation to each other, so that it is necessary to allow ¼ inch of stock to be ground out.

When we consider that the finished diameter of the hole is only 1⅛ inches, we see what a proposition this is on account of the very small wheel which must be used, and remember that the hole is about 2½ inches long. After one hole has been ground, the door is swung on the master plate, to bring the other hole in position.

to be a perfect fit in order to prevent the introduction of nitroglycerin or any other explosive used by the gentlemen of the burglar profession.

The door next goes to the machine shown in Fig. 5, where the outside face of the door is ground off to receive the ring which supports it in the swinging yoke.

Fig. 6, mounted on one of the new grinding machines recently installed. In a safe of this size the body weighs about 3800 pounds and is held in the sort of box chuck shown. This grinds out the openings for the doors. This machine grinds the inside of the lugs to the right angle to engage with those on the door, the

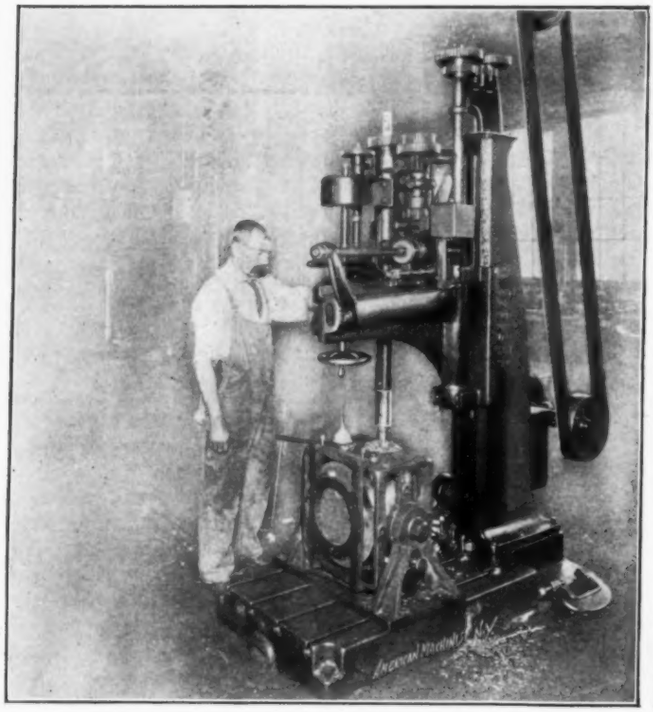

FIG. 2. DRILLING HOLES IN THE INSERTS

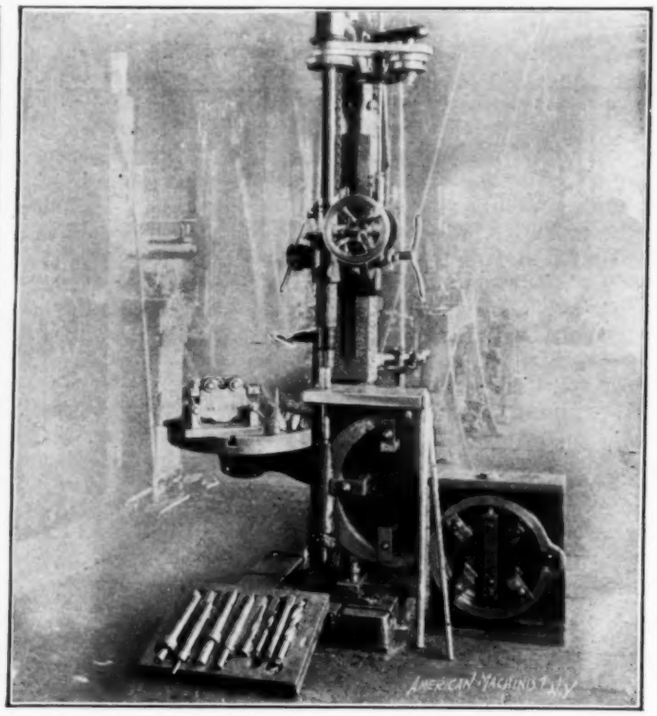

FIG. 3. DRILL JIGS FOR DOOR YOKE AND FRAME

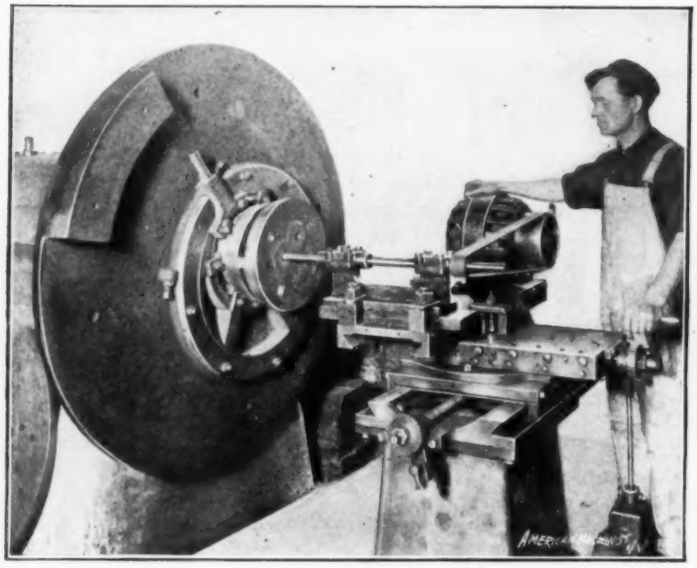

FIG. 4. GRINDING COMBINATION BOLT HOLES ON LARGE MASTER PLATE

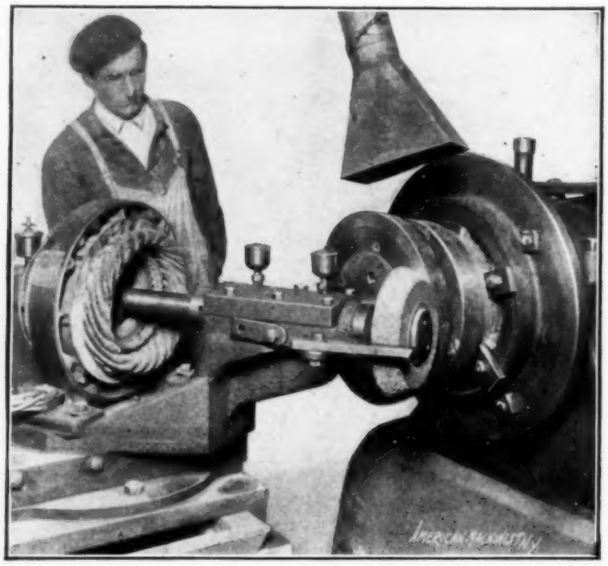

FIG. 5. GRINDING FRONT END OF DOOR

In addition to grinding out this hole, it is also back faced by a small cup wheel, which has to be fastened on the spindle after it is put through the hole, the face or explosion chamber between the two parts of the door allowing this to be done.

It is interesting to note that every joint which can be got at from the inside has

It will be noted that the face of the wheel is beveled for this particular job, as is also the case in a number of the grinding operations. This is merely a detail for the convenience of adjusting the machine to the work.

Grinding out the Body

We next come to the body, as shown in

whole grinding head being moved in and out at the proper time by a cam under the slide, driven by the gearing and universally jointed shaft which connects them. This view shows very clearly the exhaust pipe for taking care of the particles of steel and abrasives, drawing them rapidly away from the workmen and the machine. As can be imagined, it is a nice

job to grind these heavy pieces to the correct diameter and taper, so as to have a perfect bearing at all points.

Grinding in the Doors to Keep Out Explosives

After the body and doors have been ground on the machine they go to the machine, shown in Fig. 7, for grinding in the doors. The safe bodies are fastened down to the timbers by the tie rod shown, and the doors lowered into place. Then the attachment which oscillates the door while it is being ground into a fit is fastened on the top, and the long bar drops over onto the machine with the reciprocating crosshead, which moves this bar back and forth with it. The stroke can be varied by the crank pin, the motion given usually being less than half that required to turn the door so as to fully engage the lugs. After everything is ready the door is lifted out and a plentiful supply of abrasive mixture is painted on the surfaces to be ground.

This grinding continues until there is a perfect bearing on the various surfaces, as on this joint depends the safety of the contents against burglars. It only requires a very small crack to allow nitro-glycerin to be forced in, and while the construction of this particular door makes it a very long and tedious proceeding to get into the safe even with a poor joint, great care is taken to insure a perfectly tight fit at every point. In fact, when the door is fully drawn into place it is difficult to distinguish where the door stops and the body begins.

From here the safe and door together go to the machine shown in Fig. 8. This, by the way, is the machine on which the first manganese safe was built, being a faceplate lathe, which was designed by Captain Greason for his marine-engine work. Here both the door and body are ground flush to make the joint practically invisible.

FIG. 7. GRINDING THE DOOR INTO THE BODY

Drilling for the Locking Bolts

Fig. 9 shows a very interesting drilling operation for the locking bolts to enter the body. This was shown in the background of Fig. 2, but this looks down into the opening and shows the drilling fixture in place, supported by the ears which rest on the thick lug and located by the center line at the left. This is simply a right-angle drive, the thrust being taken by the cone point shown against the back side of the fixture, and the drill being fed into the work by a short bar in the handwheel at the left. These holes receive the large locking bolt, shown on the door in Fig. 14, and prevent the door being turned, so as to disengage the lugs which hold them in place. These bolts are controlled from two sources, the combination lock on the outside, and the time lock on the inside of the door.

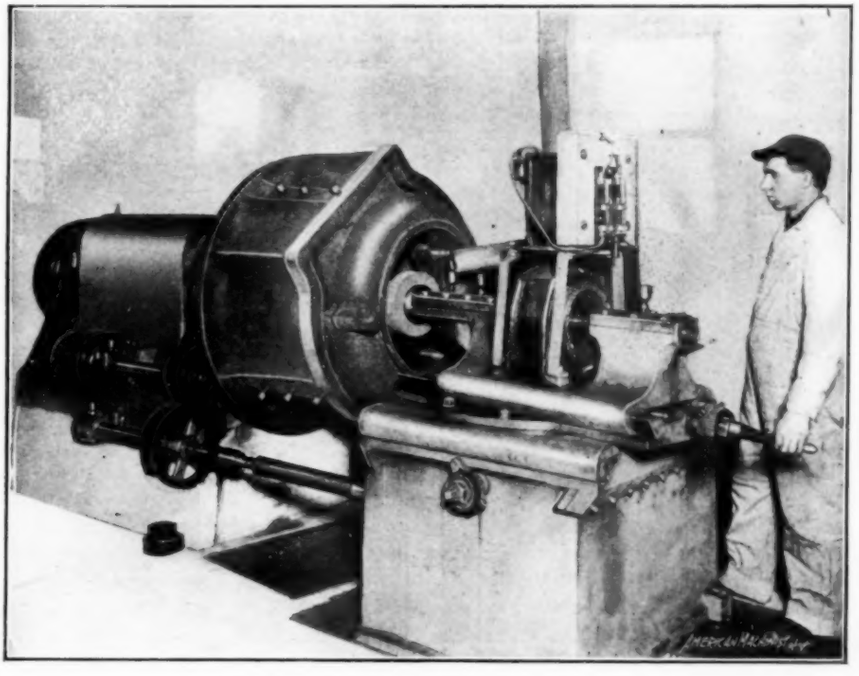

FIG. 6. GRINDING THE BODY FOR THE DOOR

Threading with a Steel Disk

Fig. 10 shows the corner where the combination-lock bolts are made. These are also of manganese-steel casting, some of the blanks being shown on the bench and on the Landis grinder. They are entirely finished by grinding, being held between centers, which are simply punched with a heavy blow, as they cannot be drilled. They are ground all over, and then go to the lathe, shown in Fig. 11, to be threaded. This is one of the most interesting operations in the shop, as it is necessary to cut a 14-pitch V-thread, 1½ inches long, on a ⅞-inch manganese bolt.

This is accomplished by using a carbon-steel disk, ground to the right angle for the thread, and mounted in place of a grinding wheel on a regular tool-post grinder of rigid construction. This steel disk only runs at a surface speed of 3300 feet per minute, but it cuts, burns, or wears away the metal, whichever you prefer to call it, and threads about three bolts per hour with as perfect a V-thread as we usually find, even when cut with a die.

The strange part of this is that it does not dull the sharp edge of the disk to any appreciable extent. These disks wear so little that they only require grinding for about every 800 to 1000 bolts cut. Over

this will be seen the exhaust pipe carrying away all particles that are cut or melted out.

Fig. 12 shows how grinding has to be done on all sorts of operations, and although this is an ordinary Coates flexible shaft, it emphasizes the processes which have to be done. There is a little wrinkle in connection with this which may be interesting in other shops. After a leather covering wears out on their flexible shafting, they send it to a sailmaker and have him put on a new covering of sailcloth. This lasts two or three times longer than the leather and is no more expensive.

The Gages Used

In all the grinding operations of the door and body great care has to be taken to gage very carefully both for diameters, tapers and length. This is made more difficult by the heat which is generated, and it is practically impossible to wait until the piece cools down before measuring it. These men, however, become very expert in measuring the hot work, and some of the gages used are shown in Fig. 13, a door being also shown, and most of the gages being arranged in the order they are used on the door.

Three of the gages are for measuring lengths, while another is a pair of interesting gages used in laying out the bolt holes on the door and in the body. One portion of these gages fits in the groove between the lug and the middle portion of the body, and one of these is slid into place on the door until the upper edge, which is in line with the center of the hole, coincides with a mark on the door, and the bolt hole is then scribed. This also locates the door in the drill jig, shown in Fig. 2. The mate to this is used in the body in a similar way and this locates the drilling fixture, shown in Fig. 9. Two other gages test the holes after they have been drilled, while another is the gage for the door, testing the location of the bolt holes.

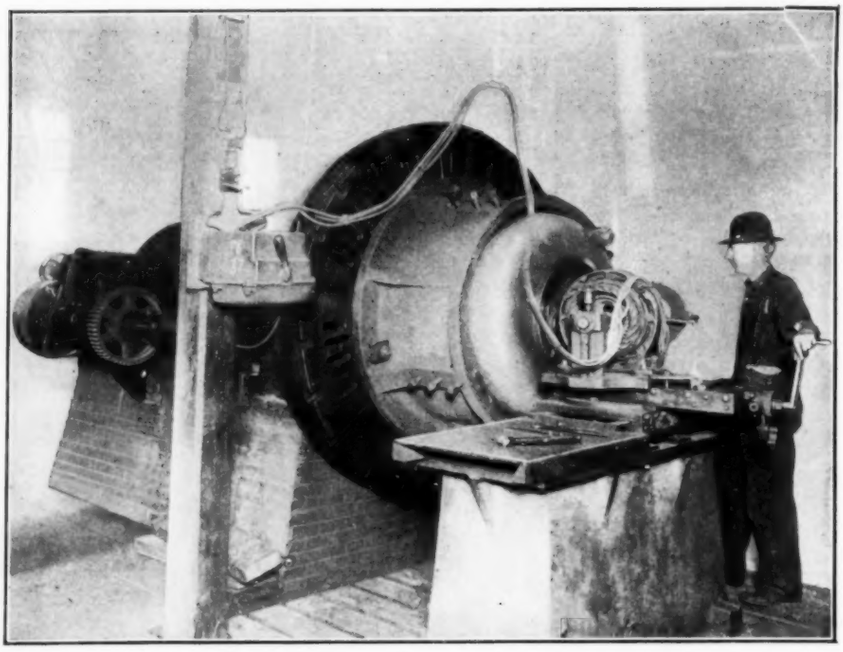

FIG. 8. GRINDING DOORS FLUSH WITH THE BODY

FIG. 10. MAKING AND FITTING COMBINATION BOLTS

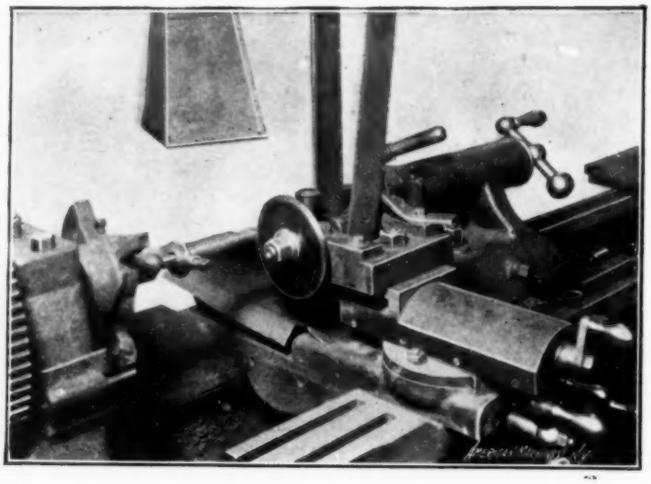

FIG. 11. CHASING THE THREAD

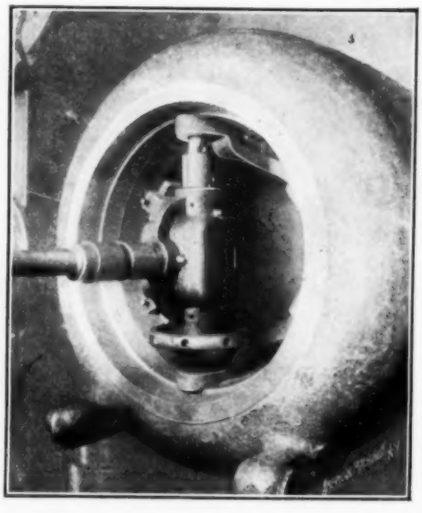

FIG. 9. DRILL JIG FOR BOLT HOLES

FIG. 12. GRINDING BETWEEN THE DOORS

Before these gages were made a novel way of locating the holes consisted of two pieces clearly shown in the halftone.

These are put in place, the spring inserted and the door put into the safe body. Then a sledge blow on each side of the safe's body gives these a movement that produces a distinct punch mark on each side of the body. This plan may be serviceable in other classes of work.

Fig. 14 shows the safe itself, and the way in which the door fits. The lugs on the door go in between those in the body and the door is then turned by the pinion shown, so that the lugs interlock and the bolt holes come in line.

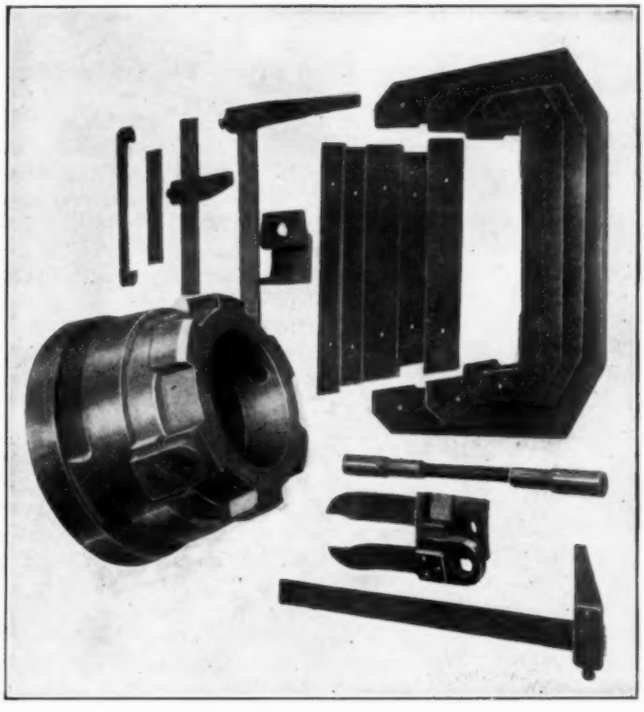

FIG. 13. A DOOR AND ITS GAGES

FIG. 14. THE COMPLETED SAFE

A Special Machine Versus a a Special Man

By John E. Sweet

At the works of the Straight Line Engine Company we have a special man, W. W. Waggoner, who is a marvel on any kind of a machine, as for instance, on a 20-inch Bullard lathe, some twenty years old, with taper attachment, he bored and threaded 100 4-inch flanges in 5 hours. Where is the special machine that for the occasional use, is in it with this? In fact, how much better can the special machine do, without using a tap, which in this case was not acceptable?

Machinists who read this will likely say that they don't believe it, or wonder if we pay him what he is worth. Well, we don't, if we did we would have to pay others more than they are worth. I know there is an outrage about it somewhere, but where?

Among the Shops

By John R. Godfrey

There's no getting away from the fact that water power is a great institution, and that it is a blessing without disguise in many places, but some of us are apt to get the idea that all we have to do is to take it without cost of any kind.

This notion of things gets several kinds of jolts when we look around Buffalo a little. This is called the Electric City by some, and yet in my observation the steam and gas engine are still doing business to an appreciable extent.

In a shop building electrical vehicles I found the power being generated by gas engines and a new one just being installed. And there's a reason. Power from Niagara Falls, 17 miles away, costs 6 cents a kilowatt, while they can produce it by gas engines, either natural or producer gas, for a little less than 1 cent per kilowatt.

Out at the great Pierce-Arrow plant, where electric motors drive the machinery in groups—the power is generated by steam engines at a less cost than that charged by the Niagara company. Yet at Syracuse, 170 miles away, the street cars are run by the power from Niagara. Again there is a reason.

Coal and gas are both remarkably cheap at Buffalo, which makes power production possible at a lower cost than almost anywhere else. On the other hand, the water-power plant represents an enormous outlay in money, on which interest must be paid, making the cost much more the water; just as power generated by a steam plant would still cost money, even if coal could be had for nothing.

But it's a good institution just the same, and there are many cities which would be mighty glad to get current at 6 cents per kilowatt.

Manganese Bronze in Place of Drop Forgings

I've run across one or two places lately where castings of manganese bronze are being used in place of steel drop forgings. One of these is the steering axles for automobiles, and they are being used on cars weighing a ton or more.

The axle and steering arm are cast in one piece, and held in the front knuckle in the usual way, the advantages claimed being that they never crystallized from vibration and would stand more abuse without breaking. When a car is run into the curbstone, as sometimes happens, these castings merely twist and bend and can be straightened ready for use, while a steel forging, if at all old, will have crystallized and break off.

This is also used for a number of other parts, the cost being about the same, perhaps owing to the comparatively small number of forgings used. A larger lot might reduce this cost.

Grinding Cylinders and Pistons

This is a very live subject in automobile circles just at this time and the pros and cons both want the floor at the same times. The builder of one of the best cars I know of contends that grinding is the only way he can finish cylinders to get the most power out of them and have them run without noise. Hard spots in the iron are sure to spring under the action of any cutting tool, as a reamer, on account of the walls being thin, resulting in high spots after these hard spots spring back into place.

Good grinding gives a fine finish, but poor grinding is an abomination, and good grinding can best be done after good boring. So he takes three boring cuts before it goes to the grinder at all. Then it is ground as straight and true as he can do it.

Pistons are ground only 0.003 inch smaller than the cylinders, except at the extreme front end, between the first ring and the end, where the allowance is 0.012 inch. This is because the piston head receives the most heat and expands the most. This 0.003 inch allowance seems very small, but prevents any "slapping" of the piston in the cylinder and allows room for lubrication.

If a little noise is not objectionable a considerably larger allowance can be made and less attention need be paid to the bore of the cylinder as the rings will take care of quite a variation without much loss of power.

Another builder allows 0.007 inch on the lands between the end of piston and the second ring and 0.003 inch on the rest. The allowance between the grooves and the piston rings is 0.00025 inch in one of the cases mentioned.

Advisability of Annealing and Seasoning Castings

There are several opinions as to the advisability of seasoning and annealing cylinder castings both on account of the desire to turn out an automobile every 15 minutes and for the reason that they are subject to heat and its distortions after they are in use. With a water-cooled cylinder the piston evidently gets much hotter than the cylinder walls and the wrist-pin lugs may cause distortion on account of the greater mass of metal. On the other hand they are not very near the head and may have little effect after all.

Careful annealing of cylinders to remove the casting strains would seem better than seasoning, as well as being much quicker, although both schemes have advocates.

Where a cylinder is kept cool by its water jacket during the grinding operation it is difficult to grind it perfectly straight on account of only the explosion end being jacketed, the lower end being a single wall in all cases. This has its effect on the expansion during and after grinding, unless water is run on the outside of the unjacketed part, which is a nuisance in several ways.

Good Reputation and Good Work Don't Always Go Hand in Hand

By E. A. Dixie

There seems to be a good deal too much idolatry in the machine business. Reputation is valuable, but, while good work will in time create a good reputation, a good reputation does not guarantee that the possessor will unfailingly produce good work.

Idolatry of good work and veneration for the firms who produce large quantities of good work often lead us to overestimate their ability and underestimate our own capabilities. A toolmaker told me a few things recently about work done by some of these venerated concerns. An order for a hundred small duplicate parts was recently placed by him with one of the infallible concerns. On testing them for accuracy he found just six out of the hundred which were good enough for his purpose. The head of his firm was in despair; at this rate it meant ordering 1700 pieces in order to get 100 useful parts.

My friend, the toolmaker, was asked what he proposed doing about it. His reply was, "Get a tool-room lathe and make them." The head of the firm ventured, "If so and so can't make them, how do you expect to?" To this the toolmaker responded, "So and so employs only *men*, and I guess we can with the same equipment, make what they do."

A fine tool-room lathe with all the necessary attachments was bought. The center fitted in a solid collet used with the draw-in attachment. One of the men made a special mandrel to fit the taper hole in the solid collet. After making, it was for some reason taken out of the collet; to the man's surprise, when it was put back again it was found to be out of true.

His reverence for the firm which made the lathe was greater than his belief in himself, and while he *knew* that mandrel must be true because he had made it so, he would not allow himself to think that the lathemaker had ever turned out a job which was not accurate. The head toolmaker was called and he found that the center could be made to run true in one position only.

The lathe builder was notified, but he, too, from the long enjoyment of a good reputation, said it was impossible his work was at fault, but on the collet and center being sent to him a new one which ran true was returned without charge.

Another concern makes a special kind of gage; these gages are made by only a few manufacturers and each one of them will impress upon you the fact that the others can't make gages.

A friend of mine had two sets of these gages made by different firms. Of the 3-inch size one was what he considered correct. He didn't really know just what was the matter with the other except that it was too small, or he thought it was too small, which is for all practical purposes the same thing. He hadn't any way of proving it was too small, but he sent it back to the maker telling him his suspicion. The gage was promptly returned with the intimation that it was correct and had always been correct. The gage was never used.

Some time ago a man with an accurate measuring machine called in and while examining it the man with the gages thought of his own two 3-inch gages and tested them on the machine. The one which he always used was found to be correct and the one which he knew was small was found to be 0.0004 inch under size. "I am glad to know that," he said, "for I can now send it back to the maker and tell him to lap it 0.0004 inch larger and not hurt his feelings by telling him it is that much too small."

The toolmaker previously referred to bought an adjustable gage reading to 0.001 inch. He checked it and found it badly out in places and so informed the maker who, blinded by his reputation, said it could not be as they did nothing but accurate work.

He then wrote the maker that he would send it to be calibrated on the understanding that if it was correct he would pay the bill, but if incorrect the maker would pay. This maker seems to have then become a little doubtful about his ability to turn out nothing but good work for he wired to have the gage sent to him. He then sent another which was found to be just as faulty as the first, but when the customer kicked a third one was sent which was found to be accurate. All of which goes to show that no one is infallible. A little skepticism when buying, no matter from whom, is a good thing. And when you are in doubt about your own ability to turn out good work remember that the other fellow "only employs *men*."

When mention of toys is made the average American usually thinks of the "made in Germany" mark, and few realize that in the present year the total shipment of American-made toys to foreign countries passed the million-dollar line. While Germany is the toy-producing country of the world (about $25,000,000 worth a year) the United States has been making marked progress in that line of industry, the total output now being between $6,000,000 and $7,000,000 a year. There are 161 toy-making establishments in the country.

Notes on Shop Heating Plants

Such Plants Are Not Difficult to Design from Well Known Constants. Showing the Forced Circulation Hot Water System for Large Shops

BY WARREN H. MILLER

One unavoidable fact about all shops is, that no matter what else may be crowded out of the appropriation, *some* form of heating plant must be left in. This distressing particular usually comes to notice in September when the building is done and a few of the more necessary tools running, with rumors of a comfortable deficit looming up from the cost department. One way out of the situation is to give 'em coal stoves and lay low until another year. But these are unwelcome from the first moment of installation, being for the most part necessarily located precisely where important tools or gangways should be.

A better way is to get out a special appropriation for a first-class heating plant, and a still better one is to include it in the original estimate, which is no very difficult matter. Some engineers bearing an eminent Metropolitan reputation, seem to think that this is a big job of estimating window and wall space and making elaborate calculations for heat surfaces. They are horrified if you point out that none of the big fan-heating companies ever makes any such calculations unless the building happens to be something unusual. In nine cases out of ten the sales representatives of the various companies visit the plant, look over the building, take the cubical contents, inquire the temperature you wish guaranteed and give you the size of fan and lineal feet of heater after 10 minutes' work with the slide rule, using their own constants. Furthermore, the variation between them will not be over 100 feet of heater pipe and practically nothing in volume of fan and size of engine. The price will vary according to the weight of metal in housing and air ducts, size of fan and quality of work put into the job.

The result, as far as temperature goes, will be about the same with any of them—just a shade above the guarantee. The difference between them will come out in mechanical efficiency and mechanical distribution of the air—things that the very scientific consulting engineers with their exact heat calculations omitted entirely to consider.

For industrial plants comprising a group of more or less isolated buildings, the fan and heater-coil system seems to offer the least operating difficulties. The engine exhaust takes care of a certain proportion of the heater coils and the balance require live steam. As steam mains are usually necessary for engines or other purposes about the various shops, and are generally larger by far than the actual consumption of the engine requires, the steam is already available for the heaters by coming out of some plugged tee that was left in when the line was put up. It then remains to take care of the return of condensation to the power house hot-well. Traps can never be depended upon for this purpose, as the best of them are prone to stick, and none can deliver against a greater head than 12 feet.

As the heating plant is of necessity centrally located in each shop, a good plan is to get a small pump and receiver instead of the usual trap offered by the heater companies in their contract. The cost of it will not be over $35 above that of the trap for a building 250x60 feet, and you now have a positive return that will deliver the hot water into any return main against any pressure and over any distance. Further, every other trap in the building can discharge into this reservoir and its water be returned to the power house instead of being thrown away.

This includes the trap on the live steam coils of the heater, which, of course, cannot in any way be connected with the exhaust, since the back pressure thus produced immediately stops the engine. A set of seven large heaters spread over a mile were thus fed from the live-steam mains, and all the condensation was delivered into a 2-inch return main to the power house by the small receiver pumps. These receivers also took care of all drip-pocket traps on the steam mains and all steam-hammer and blower-engine separator traps. Previously to this the waste from these traps—good, clean, boiler water—had to be thrown away because of the inability of the traps to lift and drive the water back to the power house.

Of course, all these fans were direct driven by their own steam engines. Now and then one hears the question raised as to using a more reliable motive power, say, an induction motor in place of the engine. This idea originates in a total misconception of the power to run the fan, which is simply the work of the engine and not the heat units which ordinarily pass through the engine to realize this work. Thus, if motor driven it will cost you the coal necessary to drive the engine and dynamo that supplies energy to the motor plus the coal needed to furnish the live steam to take the place of the exhaust-heat coils of the heater. If engine driven, the cost is simply the coal needed to make the live steam which drives the engine. Its exhaust exactly balances the extra steam you need for the exhaust coils when motor driven, and you have left the British thermal units lost in actual mechanical work done by the engine on the fan. This figures only one-sixteenth of the British thermal units needed to run the motor, assuming 8 per cent. thermal efficiency for the engine-dynamo-motor combination—a very fair figure.

Building.	Size of Building.	Fan Diameter.	Engine.	Heater.	Outlet.	Approximate Price.	Engine Horsepower.	Boiler Horsepower.
Planing mill . . .	300′x85′x46′	8′	10″x10″	7500′	54″x48½″	$2685	44.5	107.1
Foundry	250′x90′x40′	6′	7″x 7″	4100′	41″x41 ″	$1472	24.5	59
Forge shop	250′x60′x29′	5′	6″x 6″	3000′	32″x32 ″	$1060	18	42
Machine shop . .	200′x50′x22′	3′	4″x 4″	1500′	28″x28 ″	$ 670	10	21
Dry kiln	60′x20′x 9′	30″	3″x 4″	900′	25″x25 ″	$ 450	5	12

TABLE OF FAN HEATER EQUIPMENTS COMPLETE WITH AIR DUCT DISTRIBUTION.

Constants Used by Heater Companies

In figuring the size of heater plants for any given shop, let us consider the constants used by the heater companies. One of the best of them uses the following for ordinary shops of about 75 per cent. window area. Cubical contents of building divided by 150 gives lineal feet of 1-inch heater-coil pipe required using live and exhaust steam. Divide the lineal feet of heater-coil pipe by 70 and you get the boiler horsepower required for heating, and the fan engine will be either 3x4, 4x4, 5x5, 6x6, or 7x7 inches, depending upon which engine comes nearest to half of the boiler horsepower required to run the heater. There are no other sizes of engines used. The above guarantees 60 degrees inside temperature at 0 degrees outside, allowing 4 pounds back pressure for the exhaust.

Comparison with Refined Calculations

So much for commercial calculations. Just to see how the eminent consulting engineer would come out with his elaborate B.t.u. calculations, I figured out a large foundry on wall and window surface, taking standard values for heat transmission. The results fell considerably below what the heater companies were willing to guarantee on, and were quite near the next smaller standard heater equipment size. If this had been selected as being the nearest available to the figures, the

result would have been a fizzle, for the size actually put in did not stand up to 60 degrees at zero outside when first installed, and the cause was found to be entirely in the fact that no dampers had been put in the air-duct mains, though there was a complete set in the outlets.

Your theoretical man, with his two days of heat calculations giving an impossible size of heater, would, no doubt, consider dampers in the mains as superfluous, but practically it works out like this: If you close the butterfly dampers in the end outlets sufficiently to give the middle outlets a chance, the heat is deflected so sharply downward as to make that spot in the shop unbearable for man and beast. If you open the damper enough to direct the air at a flatter angle to the horizontal and thus diffuse it better, *all* the air in the main will rush for the end outlets, utterly ignoring the middle ones. Anyone who has attempted to pursuade his neighbor's hen to return through the fence by a hole in the pickets thereof will appreciate this vagary of air under pressure and supposedly bound by immutable laws to flow out of an orifice. But it doesn't, and the only remedy is to put butterfly dampers in the mains so as to check the velocity of part of the air. Whereupon it will flow out evenly from all the outlets with very little adjustment of the outlet dampers. This device proved effective in the case of the foundry referred to and brought the mean temperature up to 60 all over the floor.

The eminent consulting engineer would probably have pooh-poohed the whole scheme if proposed at the drafting table, insisted on heat calculations and would then have turned around and put a 20-foot door in the end of the foundry without any wicket door in it for industrial cars, thus losing all his heat every time a casting was sent out. But the average shop manager has no time for abstruse calculations. He would rather see a comparative table between the competing heater companies figuring on the shop in which are given the size of engine, size of shaft, diameter and weight of fan, weight of metal in fan housing and air ducts, length and size of ducts and number of sections in the heater. The standard sizes of heater coils run surprisingly close in the various companies, and the total lineal feet offered is apt to be within a few hundred feet for them all, as they are under a guarantee so they cannot get it too small, and they lose in price if they figure too large. As a matter of fact they all use about the same constants in figuring pipe and heater sizes. The deciding factors will be: (1) Reputation of the bidder; (2) quality of the fan engine; (3) weight of metal in fan floats, shaft and air ducts.

The fan floats are first to wear out, as there is always more or less moisture in the millions of cubic feet of air they handle daily. If the shaft is too light there will be endless trouble with hot fan bearings and vibration. As the fan engine is one of the essential features of the equipment, and as it must run continuously with very little attention, it must be well and amply built and its oiling system must be simple and reliable. A good splash system with totally inclosed case and grooves to catch and distribute the splashed oil is the simplest and best. A pump does fairly well until something gets under the seat of its check valves, say a speck of grit, and breaks its suction. Then the babbitt is sure to melt out of the connecting rod and things get damaged unless someone happens to be around. It does not take over 10 minutes after stoppage of the oil for the babbitt to melt out, and after a few such experiences you will fit the engine with oil cups and disconnect the pump.

Placing a Heater Equipment

In placing a heater equipment, there is no trouble at all in putting it overhead, provided the engine gets one or more I-beams directly under it. A heating equipment for a 250x60x24-foot average hight forge shop comprising a 5x5-inch vertical Sturtevant engine with heater to match, was mounted on a platform and placed over a muffler oven, as floor space is too valuable in the forge shop to waste any of it. In all small sizes the heater coil headers have two feet under which the platform I-beams should go, figured for the entire weight of the heater and housing. In the larger sizes such as heaters for 8x12 and 9x14 fans, the heaters are double, making three supporting I-beams, the center one carrying half the load and the outside ones one quarter each.

Other Heating Systems

Besides the fan system, there are several other heating schemes which work well enough to have their ardent supporters. The old-fashioned heater coil of 1¼- or 1-inch pipe, hung on pipe racks along the walls will always heat the shops after a fashion. It takes three times as much lineal feet of pipe for the same heating effect as if used in a heater coil with fan, and costs nearly as much in the end. It is difficult to drain and yet save the condensed water, and the water hammer in cold weather is a good deal of a nuisance to obviate. If left without steam on, it is nearly sure to freeze up over Sunday, as more or less water will always lie in the pipes.

Another variation of this same device is the overhead horizontal heater pipe arrangement, with pipes laid parallel across the bottom chords of the roof trusses. Among the New England mill buildings this is very prevalent, the pipe being thin, lap-seamed 4-inch tubing beaded into a special flange. While it seems to work well, and certainly takes up no valuable floor space, it always looks like beginning at the wrong end to heat a shop. A most excellent way to create strong drafts of air up a machinist's spinal column, if there is anything in the theory of the circulation of air. Tests on the number of lineal feet of pipe needed to guarantee a given temperature in the shop have never been published to my knowledge. With both of these types of heaters a vacuum pump and special check valves will take care of the return of condensation most effectively. It, however, entails the use of a special and therefore expensive system of check valves.

Hot-water System

When shops reach any considerable size, it becomes nearly impossible to heat them properly with fan-blast systems. A large locomotive-erecting shop, say, 700x500 feet, with two main bays and a large sawtooth center floor, will take at least four of the largest size heaters—about 9x14 fan and heater to match. These must be distributed in order to bring the air conduits down to anything like reasonable dimensions, and the steam and exhaust mains they require are a problem in steam transmission in themselves. The best way out is to use the enforced hot-water circulation system.

This is nothing more elaborate than a centrifugal pump in the power house, which draws the cold return main water from the entire works and forces the water through the heating device and out over the works again. It is the best "vacuum system" ever invented. It never sticks, nor runs hot, nor freezes up. The heat is shoved along to where it is wanted, and the cold water is yanked back to the heater and there are no two ways about it. A shop of the size referred to would easily be taken care of by a single 8-inch hot-water main well insulated. The water passes down this at high velocity and is distributed slowly to risers and downcomers on all the columns of the shop. Once back in the return main it again is run at high velocity through a comparatively small pipe in comparison with the heat-radiating pipe system. As regards the heating device, it is not hard to find a source of heat available around a power house. Of these the one least likely to interfere with heating the boiler feed water is the condenser for the main engines. To get a relatively high temperature, say, 160 degrees, the vacuum is carried at about 20 inches and the two top rows of tubes of the condenser are divided off from the rest and the water to be heated passed over these tubes where the steam vapor first strikes the cooling water.

If the condenser is barometric, or jet, or if the engines are run noncondensing, an ordinary feed-water heater of the closed type may be inserted between the exhaust and the condenser and the return cold water driven through the tubes of the heater before going out over the works. This system offers so many opportunities to utilize waste heat, either from mufflers,

ovens, economizer rigs, etc., that it should be carefully considered even when conditions are right for a fan system.

One company, exploiting a hot-water system somewhat as outlined above, offers a wooden insulation or protection for the hot-water mains. In an industrial plant, however, this is open to many objections, since the works grounds are always being dug up for one purpose or another, and such protection is not likely to stand much mauling with picks and shovels, besides being subject to rot underground, to say nothing of leaks from warping joints. It is better by far to follow the steam-distribution lines overhead and insulate the hot-water pipe just like the steam pipes with magnesia packing and a complete covering of ready roofing tied on with copper wire.

If the pipes must go underground, the most durable conduit is vitrified "gutter" drain tile, which comes like ordinary drain pipe in 30-inch sections, only it is parted down both sides so that a smart blow of a trowel will divide the pipe into two halves. This is laid and filled with dry screened ash surrounding the hot-water pipe. The covering is then put on, the joints being made up with neat portland cement, and you have a highly insulating material surrounding your pipe inclosed by a vitrified, water-tight drain tile. To provide for expansion, jack-knife swing joints are placed at proper intervals in brick manholes along the run of the pipe.

Besides providing air blowoffs at the tops of all risers, the only other piece of apparatus needing description is the centrifugal pump which drives the circulation. As the hot-water system is completely closed, there is no static head, but there is the inertia of the system and the friction of the pipe to overcome. So get the pump plenty powerful enough to more than drive the water along at a lively gait, since nothing is more sickening to look at than a centrifugal that has not quite power enough to get the ball started. It will run up to its maximum pressure and then churn and drop back to nothing again and the impeller gets a fresh hold only to repeat the same performance. There is no remedy—except more speed. So if it is motor driven be sure to allow for low voltage, low cycles, or both.

The appended table of fan-heater equipments giving approximate cost, including all air ducts and outlet dampers, may serve to show average practice in regard to this class of heating equipment.

Two Machine Tools—A Relic and the Original Thread Miller

By W. J. Kaup

In this day of advanced machine design when every issue of every machinist and trade journal serves us with something new in the line of machines for this, that and the other thing, we are very apt to get false notions of what machine design really is and to exceed the speed limit along that line. So let us hark back to what the pioneer machine builders left us as an inheritance to build future machines upon. The accompanying illustrations will serve as excellent examples of the machine design of the distant past.

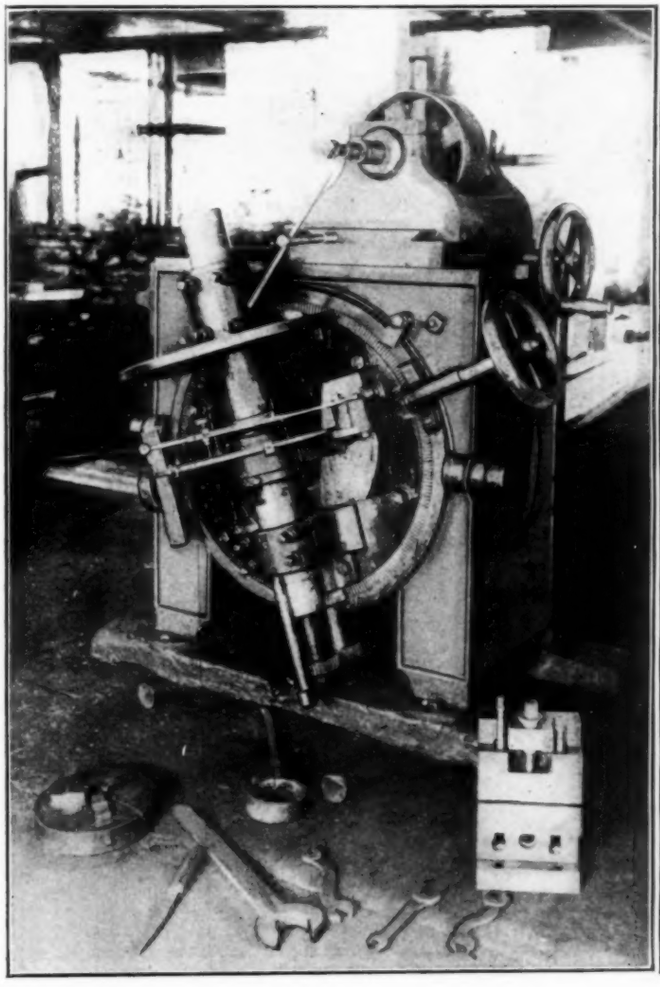

FIG. 1

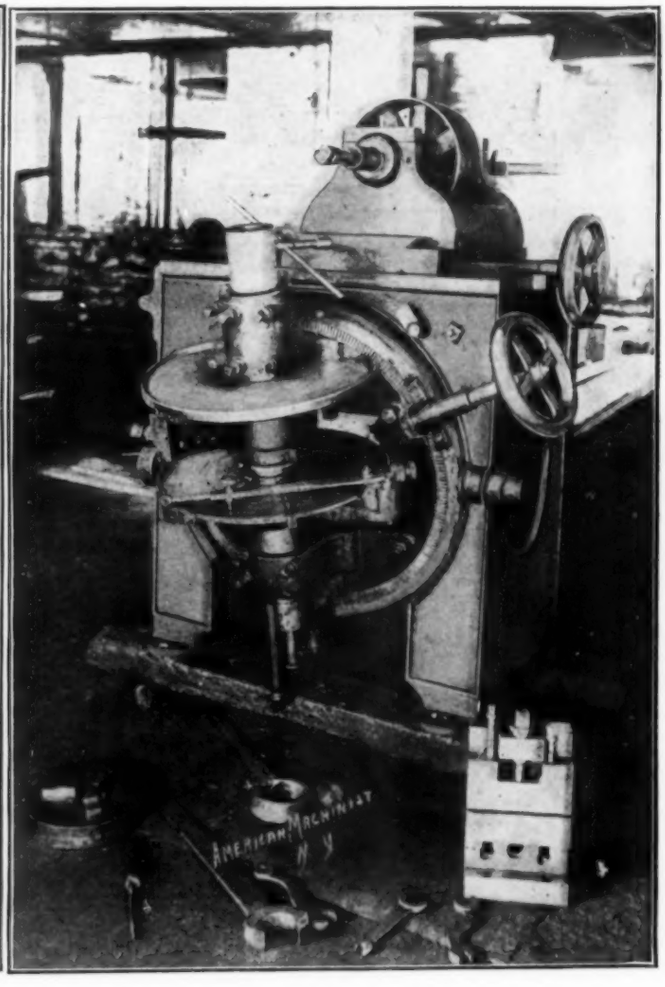

FIG. 2

A GEAR CUTTER IN USE IN 1851

An Early Gear Cutter—A Relic

This is one of the early gear cutters and universal milling machines of more than half a century ago, and reveals a type of machine design very little different from the present-day design, although built along different plans. It clearly indicates that at that early period the hollow-box principle lent itself readily to good design, together with ample bearings, large spindle, broad ways for head travel, feed

and mechanical adjustment which are all in a line with good practice today. It cannot be said, however, that there is not an ounce of surplus metal in any part of the machine which, by the way, is not so serious after all. We all wish at times that there were a few more ounces in this, that or the other part of our own modern machines. It lacks the extension arm for outboard bearings, for cutter and work both, and in that respect only, differs from modern practice.

This machine was built in Worcester by Wood & Light, for Eli Horton and installed in his factory at Windsor Locks, Conn., about 1851, the time of the starting of the manufacture of the well-known Horton chuck.

It has long been discarded and its place taken by special machinery, but it is traditional from the many years of its service that they never found a job that could not be done and done well on it and since it has been discarded on one or two occasions when a special job was necessary and no other machine would do, the relic was brought into use and again delivered the goods.

General Construction—Head

The cutter has both rotation and feed, the whole head traversing the full width of the machine, either by hand by the large wheel shown at the right of the head in Fig. 1, or by belt from the back of the machine through the medium of bevel gears. When these are connected from the spindle to the feed screw the belt is run over two idlers to maintain a uniform tension for any position of the traveling head.

Chucking Spindle

As shown in Fig. 1 this large vertical spindle is carried in two bearings which are part of the whole front ring. The work was either carried by a chuck or a spring collet which fits into the taper in the end of the spindle.

Through the medium of the gearing which encircles the whole front casting and which carries the work spindle, the work could be thrown at any angle desired for bevel gear cutting or other purposes. Fig. 1 shows an angular position.

Index Plate

As shown in Fig. 2 the lower large disk which was carried by the work spindle and rotated with it in a direct ratio, acted as the index plate for sub-division of the work; it has the same type of fingers for fractional divisions as our present ones. By careful study, the varying row of holes may be seen. The index pin was carried by the long lever which lies across the front of the plate.

Spiral Work

The large central ring or casting which carries the work spindle and plate fits into the main box casting on a ball joint, and is sustained by an extension arm or casting which fits into a circular bearing or ring which ribs the center of the box casting. This allows the whole front to move in a plane with the cutter spindle, allowing for any spiral that may be desired.

The whole general design is in keeping with present practice, and one that insured accurate product.

The Original Thread Milling Machine

Along this same topic of early machine design an even more striking example is here illustrated of the original thread-milling machine, as designed and patented by Eli Horton, the founder of the same company. We are likely to accept the thread milling machine as a development of the last 10 years, but the original machine was designed 40 years or more ago, and one machine was built at that time by the Pratt & Whitney Company, of Hartford, Conn., for E. Horton & Son Company, manufacturers of the Horton chuck.

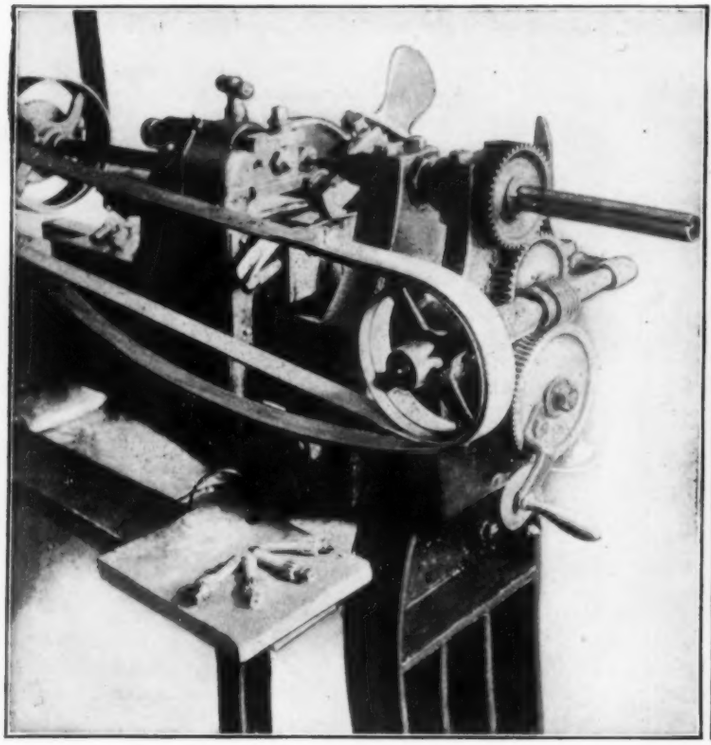

FIG. 3 THREAD MILLER BUILT OVER 40 YEARS AGO

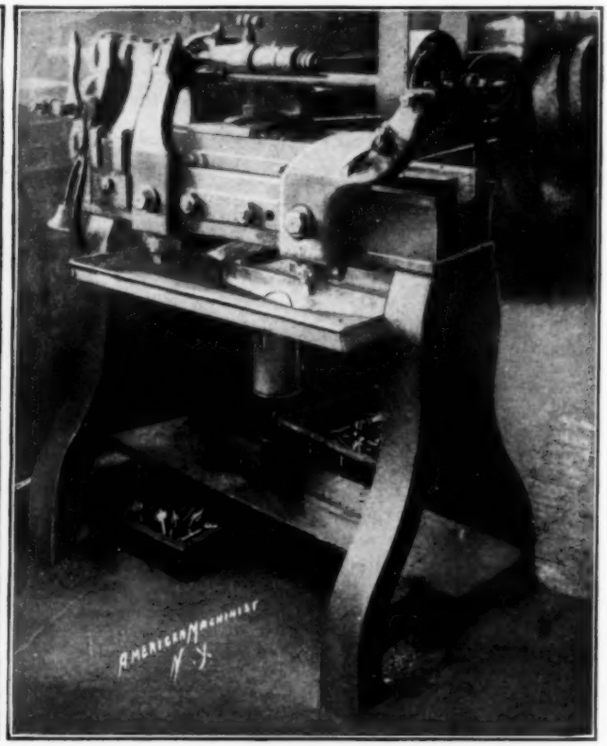

FIG. 4 THE ORIGINAL THREAD MILLER

It speaks well for both design and workmanship to know that it has been running continuously since the time it was built. Here we have not only the fundamental principles of our modern design, but a beauty of outline, a regard for appearance as well as efficiency.

It is interesting to note that at that early date the machine was designed for change of lead screw, for every change of pitch desired, and more remarkable still, is the fact that although many modern designed machines are installed beside this one, this particular machine is still doing business and is doing it as accurately as her better dressed sisters in the same group. A continuous service of over 40

years speaks well for our pioneer machine-tool designers and builders.

General Construction

Fig. 3 gives a general view of its construction and also the product—*screws* for *chuck jaws*.

The feed is worm driven through the medium of the belt which shows an extra lap for change of length of the screw if desired. The central splined spindle carries the chuck which holds the square end of the screw and has extra length for the same reason, change of screw length. The lower gear with handle attached is direct connected to the feed or lead screw, and is quickly removed when change of pitch is required.

The rotation of the lead screw through a nut which is fastened to the yoke which carries the cutter advances the cutter along the work.

Cutter Spindle

Fig. 4 gives a front view of the machine, showing the cutter spindle with vertical belt drive. This spindle has ball ends, and fits in ball sockets to enable it to be thrown at any desired angle to suit the pitch.

This cut also gives a clearer view of the feed trip with bell attached which rings when the automatic stop is released. On the back end of the cutter spindle is a large bevel gear that drives the feed belt pulley.

The machine would be a credit to our modern designers, and ranks with any of the many and uptodate machines with which the shops of the manufacturers of the Horton chuck are equipped.

The Horton chuck itself may be cited as an example of pioneer tool making and as with the other tools mentioned, embodies all the essential features of the modern universal chuck.

Multiple Housings for Large Planers

By J. T. Towlson

Large planers, having four, six, and sometimes eight, tool boxes many of us machinists have seen and used: and often had all toolboxes in use at one time.

Slotting machines also, are now fitted with special tool bars, whereby the machinist is able to machine both sides of the cheeks of a crank shaft at once. Another tool follows the first one, and the time on the slotting is halved thereby.

I have here to suggest a similar method for application to planers, whereby the planing time on a variety of work may be considerably lessened.

There is a small shop in the west of England where we make saw benches "for the trade," and the work has to be done as cheaply as possible. It is on this class of work where I introduced the multiple planer which effected considerable economy in the planing time of the tops of large and small saw-benches. The custom is to fit the standards of the saw-benches to the tables, and after the gap piece has been fitted, to put the whole on the planer table, and to finish the tops, the sides and the ends, all at one "setting." The old way was to do two benches at a time; but with the introduction of the multiple housings we were able to place six at once.

We had an opportunity of purchasing an old heavy planer, with ample breadth and length of table. In front of and behind the original housings we fitted two other pairs with rail, saddle and double tool boxes complete. These housings were fitted to the machine bed 10 feet 6 inches in front of and behind the original housings. Thus we had the equivalent of three planers by the application of the two extra housings; and were able to place six saw-benches with table 9 feet long by 4 feet wide on the planer table in two longitudinal rows of three each; and place them altogether, with only a 9 foot 3 inch stroke. The ends of the saw-bench tops were planed transversely by the aid of a special saddle fitted to each pair of housings applied and driven similarly to the saddle of the Richards open-side shaper.

Figs. 1 and 2 illustrate the general form of the multiple housing planer and the way in which the operations of planing six benches at the one time were satisfactorily carried out.

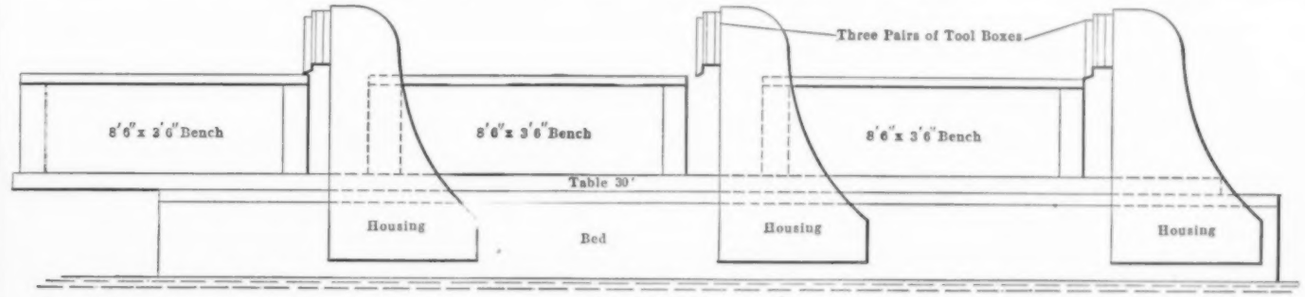

FIG. 1. Elevation

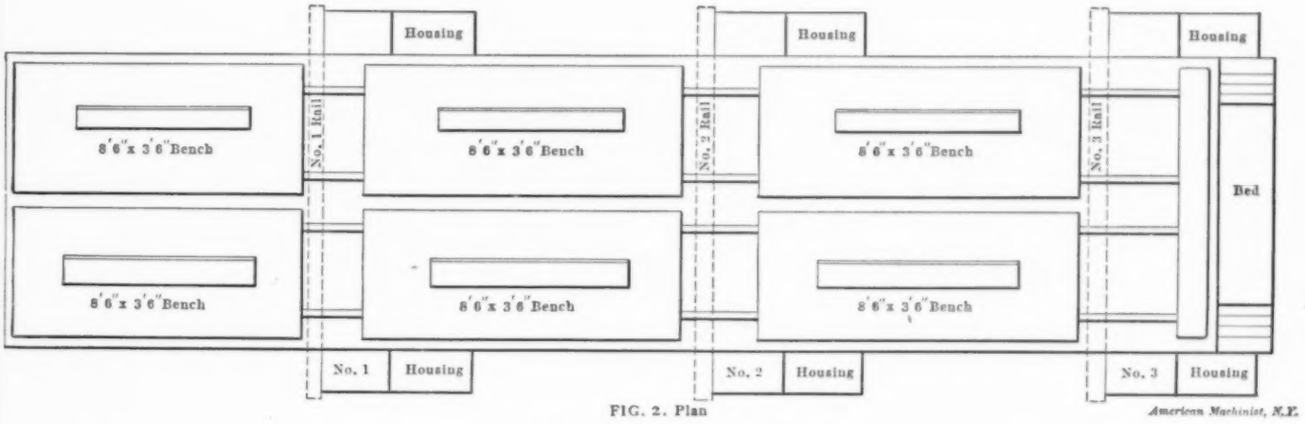

FIG. 2. Plan

American Machinist, N.Y.

A MULTIPLE HOUSING PLANER

It is estimated that about 1,700,000 mechanical writing machines are in use. In the production of typewriters the United States is pre-eminent. Under normal conditions it is estimated that about 300,000 high-grade typewriters are produced annually.

Principles and Construction of Aeroplanes—I*

Discussion of Principal American and European Types as Regards General Design and Means for Producing and Maintaining Stability in the Air

BY ANSBERT VORREITER

The most important group of power-driven airships is incontestably formed by aëroplanes. While the performance of other flying machines, such as helicopters and orthopters, is still not very satisfactory, flights of about 90 miles have already been made with aëroplanes. Wright has exceeded 300 feet in altitude. The present aëroplanes can carry two persons, or one person and sufficient fuel and oil for a flight of three hours. Wilbur Wright, December 31, 1908, made a continuous flight of two hours and 24 minutes. [The records have been greatly exceeded since the original writing of this article—*Translator.*]

The aëroplane is already available for military and sporting purposes. Doubtless it has a great future before it. Other technical branches are being influenced by the power flying machine, as they have been stimulated by automobile construction, among those branches being steel manufacture and the design of internal-combustion motors. Of materials and motors the airship makes more exacting requirements than does the automobile.

The development of the flying-machine art is similar to that of automobile technology. First, vehicles were built for purposes of amusement. As progress was made, there took place a differentiation of types by different makers. The following paper will compare the principal forms of aëroplanes in order to determine the best arrangement of their most important elements.

No standard form of aëroplane has yet developed. Beside the diversity in the number and arrangement of the supporting planes, there are still divisions of opinion on the best shape for planes, both transversely and longitudinally in the direction of flight. Wright, Voisin and others arch the surfaces only in the flying direction, as has been done by Lilienthal in his gliders, Figs. 1 and 2. Other constructors, for example, Ferber, turn the ends upward on both sides, forming an obtuse V, Fig. 3. Curtiss inclines the lower supporting planes upward, the upper downward, Fig. 4. [This applies only to the Curtiss machines made before 1909.—Editor.] Tatin curves only the ends of the surfaces upward, Fig. 5. Similarly, Etrich and Wels, in Vienna, curve the main planes of their single-deckers. Let it be remarked that Lilienthal had already curved the planes of his glider upward in that manner.

The V-form of Ferber has the disadvantage that a side wind tends to tip the flying machine. Furthermore, the sustaining power of upward-turned surfaces is lessened. The advantage of the V-form is that, in still air, it imparts lateral stability to gliding and flying without further means. This was shown in experi-

α = Angle of Incidence of Aero Curve.
h = Hight of Curve.
w = Projection of the Curve.
w_1 = Projection Producing Head Resistance.
a = Condensed Air.
b = Rarified Air.

FIG. 1. Section of Aero Curve of an Aeroplane.

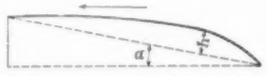

FIG. 2. Wrong Form of Curve given in a Text Book for Airship Building.

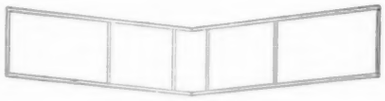

FIG. 3

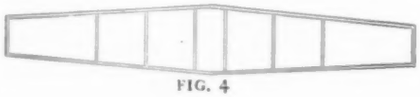

FIG. 4

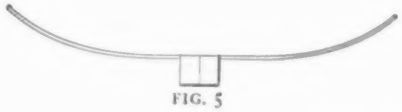

FIG. 5

American Machinist, N.Y.

DIAGRAMMATIC FORMS OF AËRO-SURFACE SHAPES OF AËROPLANES

ments earlier made by me, to be attainable, quite as well, without taking into the bargain the disadvantages of the V-form, if the lower supporting planes of the double-decker were made smaller than the upper ones. Similar results have lately been obtained in Lichterfelde, by Lentz, who cuts away the middle part of the lower plane. In both cases, Figs. 6 to 8, there is a result of making the resistance of the upper plane considerably greater than that of the lower, so that the flying machine cannot tip when gliding, even if the center of gravity be situated midway between the planes.

Similar differences are found in the arrangement of the propellers. Wright employs two screws behind the main planes; Farman, Delagrange, Ferber and others place the screw back of the planes, but use only one. These builders speed the screw the same as the motor; that is, 1000 to 2000 turns per minute, while Wright reduces it. The number of propeller blades varies between two and four; two-bladed screws are generally used. It is evident from all experiments that the slow screw, turning at about 400 revolutions per minute, has far better efficiency than the high-speed ones. But the appliances for transmitting power and reducing speed in the slow motion consume at least 10 per cent. of the motor output, so that a large part of the superior efficiency of the screw is lost. Further, these transmitting devices afford opportunity for accidents, since belts may slip and tear, and chains, such as Wright employs, have already broken in flight. The safest method is by toothed gearing. The best plan, however, would be to construct slowly running, and, therefore, long-stroke motors; their increase of weight would be only a little greater than the saving of weight in the power-transmitting and gearing mechanism, but their safety of operation would imaginably be great. The long-stroke motor has also the advantage of a greater air-cooling surface. Further, it consumes comparatively little fuel.

Even concerning the most important question, maintenance of stability, opinions are not yet settled. The question of lateral stability has generally been insufficiently appreciated hitherto; it has been thought to secure lateral stability by placing the center of gravity low in relation to the main planes; also by bending upward the outer ends of the main planes (Tatin, Ferber), or by providing adequate vertical planes turned in the direction of flight (Voisin). The public appearance of the Wright Brothers showed the advantages of a perfect lateral stability influenced by guides; since, by this method was it first possible to make short curves and to oppose side winds. Wright can fly in a wind of 20 miles per hour, which still today no other flier can do. The method

*Translated from the *Zeitschrift des Vereines deutscher Ingenieure*, by E. P. Buffet.

A paper presented to the Berlin section of the Verein deutscher Ingenieure.

[By way of condensation several illustrations appearing in the original have been omitted.—Ed.]

devised by Wright, of producing lateral stability by warping the main planes, patterning after birds, could hardly be excelled in principle; it, however, allows of improvements. Beside the Wright method has been employed that of Blériot, Ferber, Curtiss and recently also, of Farman, in which small adjustable planes are placed at the outer rear ends or edges of the supporting planes. A method earlier used by Blériot, and often since, of making each side of the supporting plane singly adjustable, Figs. 9 and 10, has not been successful, and the fault of this *prima facie* excellent plan lies in the considerable power required to adjust surfaces so large, a power varying with the strength of the wind and velocity of flight. If the axis of rotation of the supporting planes were placed just in the middle of them, still there would be a force in front tending to turn them upright and the operator of the aëroplane must continually exert an effort to oppose this turning moment. That is because the air striking the forward part of the plane is not already deflected; it is constantly being initially pressed downward and its pressure per unit of surface on the hinder edge of the plane is, therefore, less than on the forward edge. This relation of pressure varies with the velocity with which the air strikes the planes, and, therefore, with the strength of wind and speed of flight. Naturally, this is true also of small planes, such as those which Blériot, for example, Figs. 11 and 12, places on the outer end of the main planes of his new single-decker, but in consequence of the smaller surface, the pressure on the connecting lever is here easily overcome. The small planes work excellently because of their long lever arms, they being placed on the outer end of the main planes.

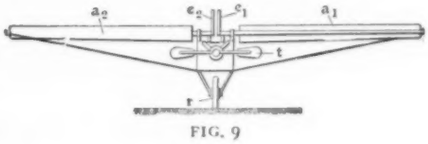

FIG. 9

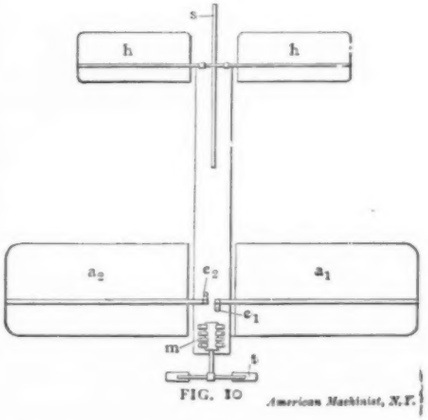

FIG. 10 *American Machinist, N.Y.*

AËROPLANE WITH ADJUSTABLE SUPPORTING PLANES TO CONTROL STABILITY

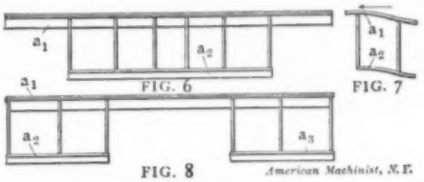

FIG. 6 FIG. 7

FIG. 8 *American Machinist, N.Y.*

EXAMPLES OF UNEQUAL MAIN SUPPORTING PLANES

Lateral stability is, among many builders, influenced by the same provisions that serve for turning control. Wright curves, or warps, the main planes with the same lever that actuates the turning rudder; by means of a joint to this lever he can also only warp the planes, and *vice versa*.

Simplicity now prevails in respect to the turning rudder; in all aëroplanes it is placed behind the main planes, only its distance from those planes is far from uniform. From this arrangement may be excepted the aëroplane of Santos-Dumont, Fig. 14, with which the first officially recorded flight of 500 feet was made, and the double-decker of Blériot. On the contrary, we find the rudder for control of elevation arranged both before and behind the supporting planes, while a few constructors, for example, Mengin and Gastambide, have believed that a special rudder for elevation could be entirely dispensed with, Fig. 15. I, however, consider a rudder for elevation as unconditionally necessary, since it is only by that means that the flying machine can be controlled vertically if the motor gives out; compare the Antoinette flyer. An aëroplane without a rudder for elevation, if the motor fails and the propeller at the front of the machine, thus being stopped, acts as a brake, may upset, which took place in the trials of Gastambide's flying machine. So long as the motor is in order, its speed can be increased, thus raising the machine, or decreased, thus allowing it to slide downward, the velocity of flight being at the same time accelerated or retarded. An aëroplane without a vertical rudder must, in order to have sufficient longitudinal stability, be very long, and furnished with a tail supporting plane. If a tail plane must be provided it may be

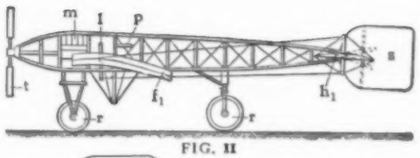

FIG. 11

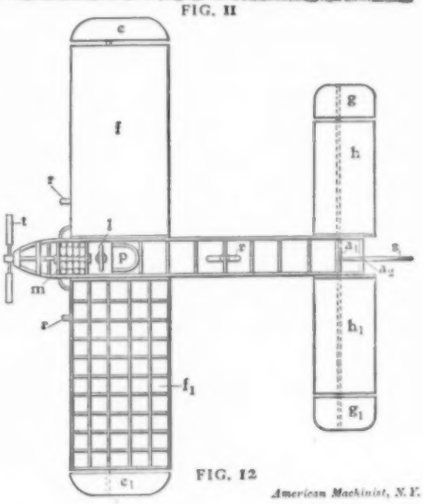

FIG. 12 *American Machinist, N.Y.*

AËROPLANE (MONOPLANE OF BLÉRIOT) WITH ADJUSTABLE SMALL VANE ON THE ENDS OF THE MAIN PLANE AND FRONT CONTROL

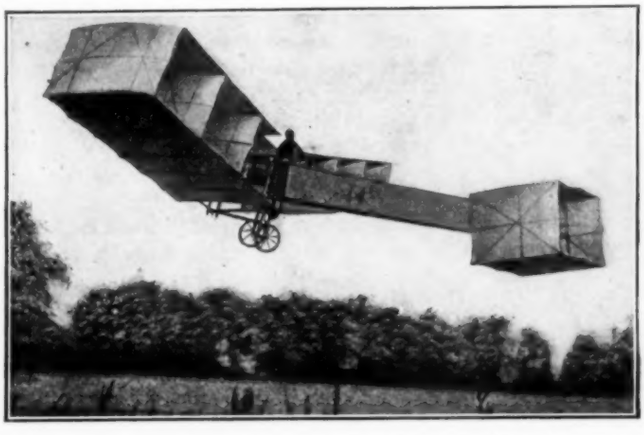

FIG. 14. AËROPLANE OF SANTOS DUMONT (14TH) IN FLIGHT

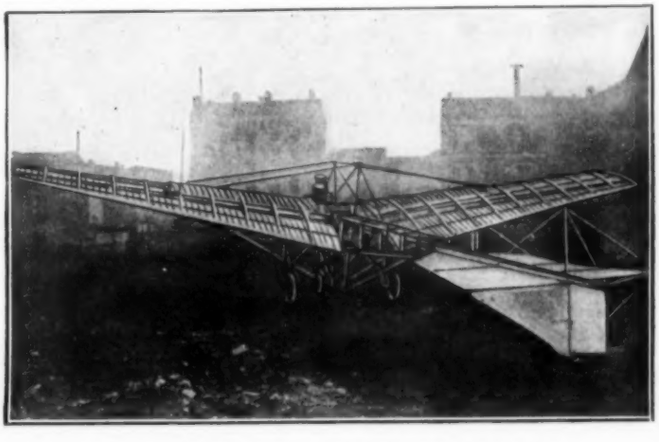

FIG. 15. AËROPLANE OF MENGIN AND GASTAMBIDE WITHOUT CONTROL FOR ELEVATION

adapted to control the elevation by arranging it to turn about a horizontal axis at right angles to the longitudinal axis of the flying machine. It may here be mentioned, that in the case of double-deckers, an attempt is made to employ one main plane itself as a control for elevation, and for this purpose Jatho, of Hanover, has made movable the top supporting plane of his three-deckers and later of his double-deckers. This form of construction is now imitated by Levy-Gallat. Several constructors have also placed one rudder for elevation forward and another backward; for example, Santos-Dumont, in his single-decker No. 19; also Kapferer and Esnault-Pelterie. Practice has taught that placing the rudder for elevation before or behind the supporting planes works about equally well. Two rudders for turning, one before, the other behind, the supporting planes, have been tried, and the Wright brothers in their second patent (French No. 384,124) have described such an arrangement for turning control, in which an immovable vertical plane is placed behind the front rudder for turning. The Wrights do not, however, use this arrangement any longer, Figs. 17 and 18.

Very different is also the loading of aëroplanes per unit of supporting surface; it varies between 1.7 to 5.2 pounds per square foot. Single-deckers can be more heavily loaded per unit of supporting surface than double-deckers. In the single-decker II of Esnault-Pelterie, the load is almost 5.2 per square foot, while the double-decker of Wilbur Wright carries for one person 1.9 pounds, and for two about 2.2 pounds per square foot.

The greater the load per unit surface, the faster must the flying machine move in order to maintain itself in the air. Therefore, the single-decker of Esnault-Pelterie flies much faster (51 miles per hour) than the double-decker of Wright (36 miles per hour). Since the resistance is proportional to the square of velocity, aëroplanes that are heavily loaded per unit of surface, and therefore must fly quickly, employ correspondingly more power in proportion to the weight, and require a more powerful motor, assuming equal efficiency of the propeller. Establishing a relation between the velocity and the supporting surfaces, we find that the latter in an aëroplane of 20 miles per hour speed, must be four times as large as those of 40 miles per hour velocity. Therefore, it is preferable to employ high speed, since small supporting surfaces make the aëroplane handier. High speed presents only *one* difficulty—landing. Ascent is no more difficult nor dangerous at high speed than at low, and in the air there is no risk. Landing, on the contrary, at high speed, imperils the aviator and the machine, requiring also a larger open space for the purpose.

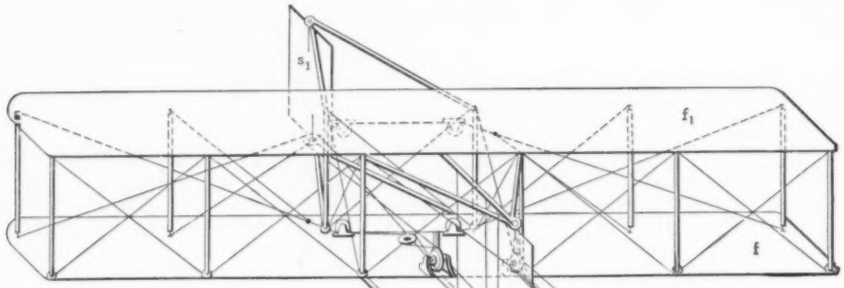

FIG. 17

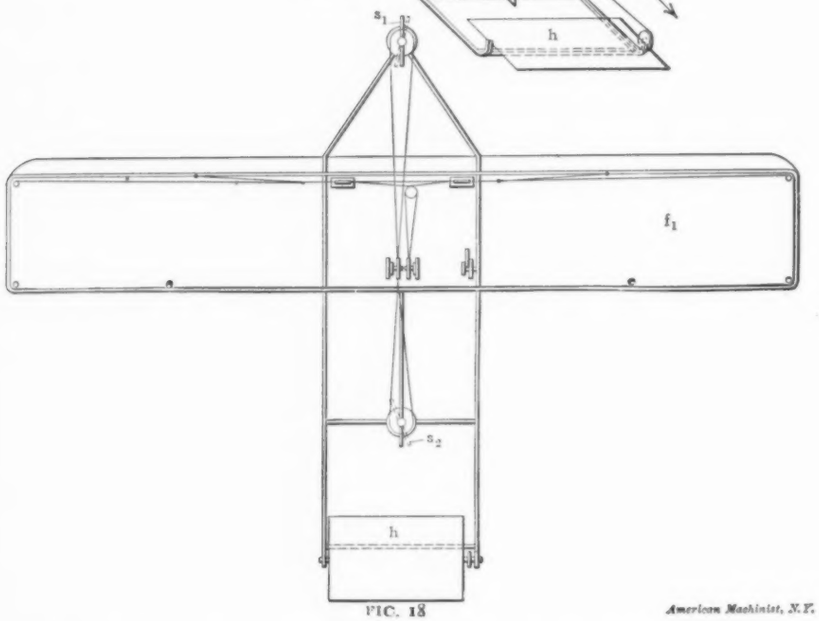

FIG. 18

American Machinist, N.Y.

REPRODUCED FROM WRIGHT BROTHERS' FOREIGN PATENT DRAWINGS

Of great importance is the angle of incidence—that angle at which the bearing surfaces are inclined from the direction of flight. The work performed in flight consists partly of the work required for ascent vertically, which is necessary in order to glide, partly of that needed for horizontal progress, Fig. 19. The smaller angles produce less resistance to forward motion, but, on the other hand, in order to obtain the requisite sustaining force, we must increase the breadth of the supporting planes. It is, therefore, desirable not to choose too small an angle. An angle of 5 deg. leads to good results, yet aëroplanes with one of only 3 deg. have flown. The use of rudders for elevation allows a certain latitude in the size of the angle.

Very great differences exist also in the relation of the breadth to the length of the main planes. Theoretically, it is favorable to make the planes short in the direction of flight, and rather to make them as broad as possible. We see also in nature that fast flyers, such as the albatross, have a very great spread (breadth, in the case of the aëroplane), while their wings are very narrow in the flying direction. It must, however, be reflected that the broad aëroplane is very inconvenient, even when the planes can be knocked down for transportation. Moreover, the broad planes are heavier in proportion to their surface, since their framework must be not only longer, but stronger. As a favorable proportion of length to breadth, the plane can be made about 1 to 6.

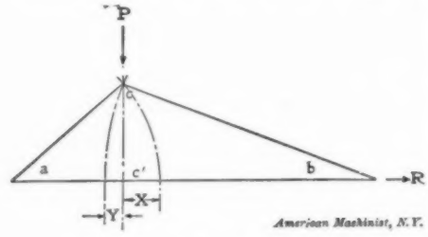

DIAGRAM OF PLANE IN FLIGHT

Of greater importance for sustaining power of the planes, is their curvature. Here, also, we see great differences, from a curvature of 1/12 rise above the chord to planes without any curvature, see Figs. 1 to 5. On this point Lilienthal has made very extensive experiments, and while he at first believed the best efficiency to be obtained with a great curvature (1/12 of the chordal length), he has later come down to 1/18 of the chordal length. This should be a favorable proportion.

Similar obscurity prevails in respect to the propellers; whether one or two; whether before or behind the main planes; whether with two, three, or four blades; whether slowly or rapidly revolving; whether driven directly or by gearing. Even the question of material is still in doubt. Wright Brothers, Pischoff, Phillips and others use screws cut out of wood; Voisin (Farman), Delagrange, Ferber, Esnault-Pelterie, Santos-Dumont, and the majority of Frenchmen in general, screws with steel tubular shafts and blades of aluminum. Santos-Dumont has also tried a steel tubular shaft and a steel skeleton with textile covering for the blades. No screw construction has yet been satisfactory in respect to strength. Screw breakages are not rare, and almost all constructors have suffered from them. Wright Brothers employ for driving their aëroplanes two contrarily turning screws placed on both sides behind the main planes. This has the disadvantage that if one screw is retarded the machine is given a lateral impulse. Still worse it is if one screw breaks. In the curve which the flying machine must describe if driven by an active propeller on only one side, it inclines, because of the relief of torque, to the outer side, and may upset if the operator does not succeed in stopping the motor, and the altitude is not high enough to permit a righting of the tipping machine. This was the cause of the disaster at Fort Meyer, near Washington, in which Orville Wright was badly injured, and his companion, Lieutenant Selfridge, was killed. To utilize the advantages of driving with two screws, and avoid this objection, they may both be placed on the same axis. The shaft of the first screw must then be hollow to let the shaft of the second pass through it.

The conditions for greatest efficiency of the propeller are not yet determined. The position of the screw forward, indeed increases the stability in the direction of flight, but the efficiency of the screw is somewhat lessened, because its air current is driven against the planes of the machine. Also, it is disagreeable for the aviator to be exposed to the sharp air current, while placing the screw behind the planes obviates any noticeable wind except that due to the speed, which is comparable with that of an open automobile. If by reason of the stoppage of the motor, the aëroplane becomes a glider, it has less stability with a forward propeller, because the screw, when not revolving, presents a resisting surface. Whether this fact is so important as to require placing the propellers in the rear, remains undecided; since no gliding tests with front-propeller aëroplanes have been made. Wright, however, has often ventured to stop his motor at a high altitude and land by gliding, in which cases he glided more than 1300 ft. His aëroplane then showed itself completely stable.

That little clearness pervades constructive principles, is due to the fact that most constructors have at their disposal little means for fundamental experiments. Here is a broad field for scientific institutes and large manufacturers. It would be an achievement meriting gratitude to determine experimentally a suitable propeller form, number of blades, rotary speed of the screw, etc. An establishment for the technics of aviation is being started in Lindenberg by means of the jubilee fund of German industry, supported, also, by contributions of the Verein deutscher Ingenieure, and there, under the leadership of Doctor Engineer Bendemann, experiment with propeller screws have been undertaken. These experiments are of great significance for helicopters. For want of good lifting screws, they have not yet reached the stage of development that aëroplanes have already attained. A forward step in their construction is first to be expected when lifting screws of good efficiency are available and the motors work so reliably that a fall by their failure is not greatly to be feared. Aside from military purposes, however, aëroplanes possess superior importance, since rapid progress in a horizontal direction is of far more use than a vertical ascent.

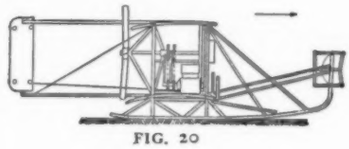

FIG. 20

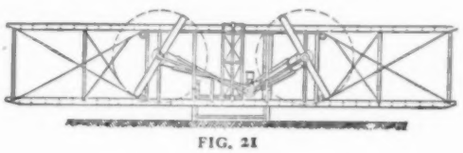

FIG. 21

AËROPLANE OF WRIGHT BROTHERS

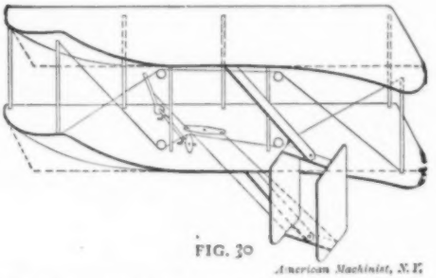

FIG. 30

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MAIN PLANES AND TURNING RUDDER OF THE WRIGHT FLIER SET FOR A CURVED FLIGHT TO THE LEFT

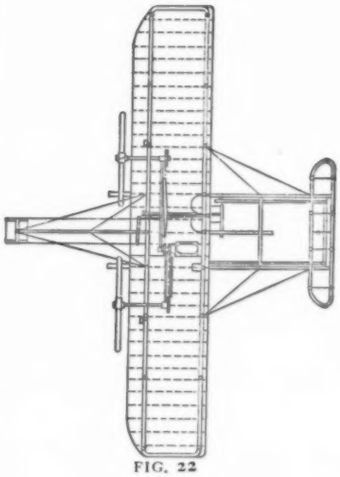

FIG. 22

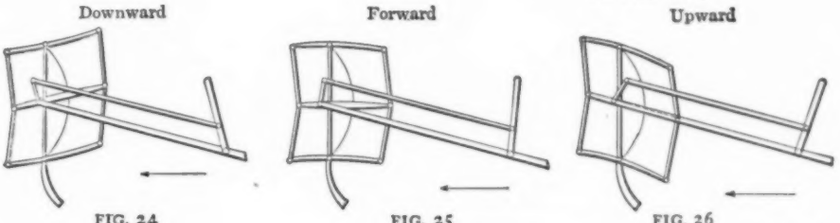

FIG. 24 FIG. 25 FIG. 26

American Machinist, N.Y.

WRIGHT'S RUDDER FOR ELEVATION IN THREE POSITIONS

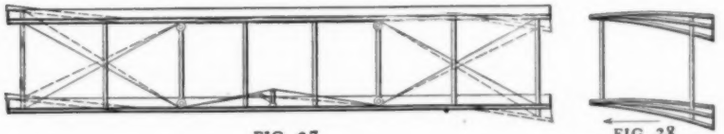

FIG. 27

FIG. 28

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DIAGRAMMATIC VIEWS OF THE MAIN PLANES OF THE WRIGHT FLIER AND MECHANISM FOR WARPING THEM

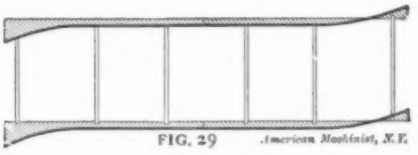


FIG. 29

American Machinist, N.Y.

POSITION OF MAIN PLANES OF WRIGHT'S FLIER IN A CURVED FLIGHT

In the construction of new aëroplanes, it is advisable to follow directly along proven lines, and after succeeding there, to experiment with new arrangements, but in every case only *one* improvement at a time. Aëroplanes, as is known, are classified according to the number of supporting planes, as single-decker, double-decker, and three-decker (monoplane, biplane and triplane). Hitherto the most extensively used have been double-deckers, and with them the best flights have been made. Attention may, therefore, be now confined to them.

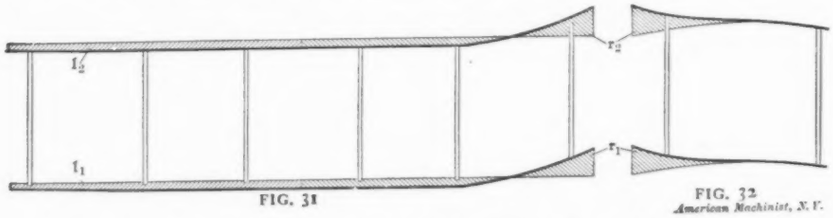


FIG. 31 FIG. 32 *American Machinist, N.Y.*

MAIN PLANES OF AN AËROPLANE WITH THE CONTROL FOR STABILITY BY WARPING ONLY ONE END

Individual Forms of Construction

The most important form of construction among aëroplanes, as among power flying machines in general, is that of the Wright Brothers. Wilbur Wright, with his double-decker, holds all records. (Since the time of writing, Wright's records have been surpassed.) This aëroplane is already regularly manufactured by the Compagnie Générale de Navigation Aérienne, in Paris and Dieppe,* and will be introduced into the armies of France and the United States for the purposes of conveying orders and of reconnissance. Aside from Wright Brothers themselves, four persons are today competent to control this machine.

The Wright flying machine may serve as a typical example of a double-decker; almost all other constructions are more or less influenced by it. The principal elements are arranged in the following manner: In the middle are the supporting planes, in front of them the rudder for elevation, behind them the rudder for turning, Fig. 22. All these planes are constructed as double planes. A tail plane for maintenance of stability in the direction of flight is lacking, this purpose being accomplished by the rudder for elevation. Lateral stability is produced by the main planes. Wright Brothers have entirely discarded the idea of securing steadiness in the two directions automatically; the aviator must stabilize both in the flying direction and laterally through appropriate manœuvers. Apparently this is a disadvantage as compared with the automatically stable flying machines, of Voisin, Ellehammer and others. Wright Brothers' success is attributed directly to their method of stabilizing, but it may be due quite as much to their skill acquired by long practice. The steering mechanism of the Wright flying machine is more finely constructed than in others previous to the public appearance of the Wright method of construction. The rudder for elevation is distinguished by the fact that both its planes, when it is turned around a horizontal axis transverse to the path of flight, are curved equally, their edges being inclined upward for downward steering, and downward for upward steering, as shown in Fig. 24 to 26. By means of the air pressure on these planes, the rudder for elevation is raised or lowered, and thus the angle of incidence of the main planes is changed. If it be greater, the aëroplane is lifted by the air pressure and ascends; if the angle be decreased, the machine sinks. Through the curving of the vanes the rudders for elevation, when ascending, act also as supporting surfaces, an essential advantage as compared with the rudders for elevation of other aëroplanes, which being flat or slightly curved, have planes for control of elevation that are unalterable in curvature.

In other aëroplanes, specifically in most single-deckers, the rudder for elevation is placed behind the supporting planes and there is no purpose of making the curvature of its planes variable. The rudder for elevation must then be turned in the opposite direction; therefore, in ascending the forward edge is brought down, the rudder for elevation is depressed by the air pressure and thereby the angle of incidence of the supporting plane increased. In the use of the rudder for elevation as a supporting plane, this is a disadvantage; on the other hand, the position forward possesses an objection that the rudder is easily damaged in landing, and it partly cuts off the view of the aviator. In itself the rudder for elevation works equally well before or behind the main planes. Placing it behind has, however, the decided advantage that the rudder planes maintain the stability in the direction of flight after the manner of the tail planes in flying machines of Voisin, Ferber and others. If a gust of wind depresses the main plane, the resistance of the rudder for elevation is increased and thus there is a tendency to increase the angle of incidence of the main plane. It is the contrary with a forward control for elevation; in that case the aëroplane might fall if the aviator did not counteract it with the rudder for elevation at the right time. Since the control of a flying machine is far more difficult than that of an automobile or vessel, for example, it is desirable to employ every good method to simplify the steering. Consequently, if there be no tail plane for maintenance of longitudinal stability, the control for elevation should better be placed at the rear. By dispensing with the tail planes the aëroplane is made simpler, lighter and cheaper, there is an essential saving in length, and the elements for descent of the flying machine are smaller.

The maintenance of lateral stability in strong and variable winds is obtained by Wright Brothers through devices which they have imitated from birds. At the

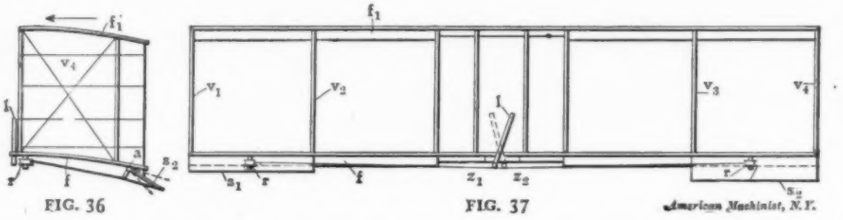


FIG. 36 FIG. 37 *American Machinist, N.Y.*

MAIN PLANES WITH PERPENDICULAR INTERMEDIATE PLANES IN THE FARMAN-VOISIN AËROPLANE

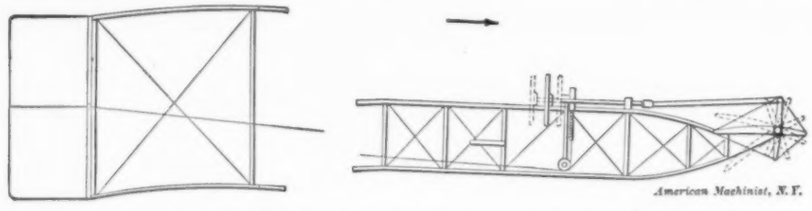


FIG. 35. MOVEMENTS OF THE RUDDER OF THE FARMAN-VOISIN AËROPLANE

*In Germany a company for the manufacture of the Wright aeroplane has been formed in affiliation with the Allgemeine Elektrizitaets Gesellschaft.

time of the first public appearance of the Wrights, almost all aviators attached highest importance to automatic maintenance of lateral equilibrium, and generally they endeavored to accomplish this result by placing the center of gravity low, but all later constructors have more or less abandoned this plan and have made lateral stability dependent upon the alertness and skill of the aviator. In the aëroplane of Wright, the center of gravity lies only a short distance under the center of resistance of the flying machine,

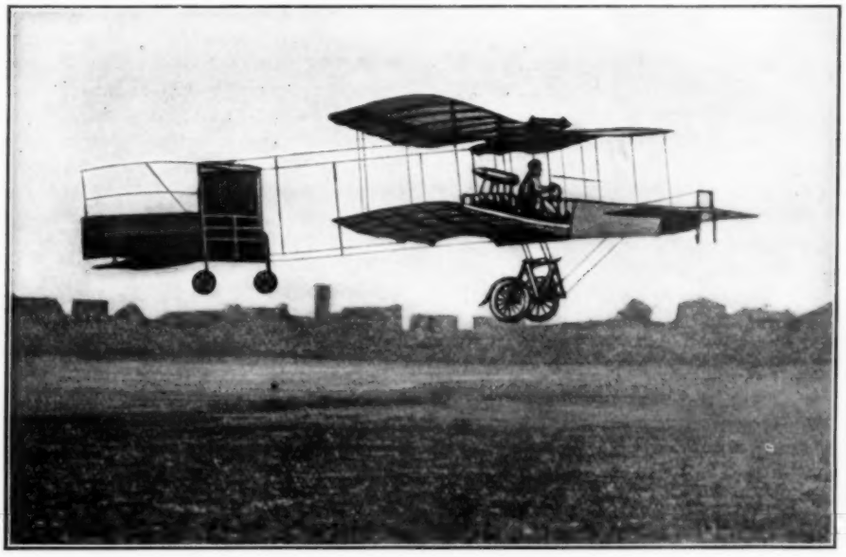


FIG. 38. FIRST CONSTRUCTION OF FARMAN-VOISIN AËROPLANE

since the motor and all driving mechanism and appurtenances, as well as the aviator, are placed between the two main planes. If the machine is inclined by a side gust of wind, the operator restores it to its central position by curving the main planes, at the hinder edges, on the low side downward and on the high side upward. Then the air pressure raises the former and lowers the latter. When the machine is restored to its horizontal position, the surfaces are bent back to their normal shape, Figs. 27 and 28. This warping of the main planes can be graded at pleasure, which is not so perfectly accomplished by stabilizing appliances with hinged planes. Yet this cleverly devised arrangement of Wright has one great fault. It is known that the supporting planes are arched to increase their sustaining power. The warping increases the arched effect on the side that is bent downward and decreases it on the side bent upward, which creates a difference between the flying resistances of the two sides. Fig. 29, in which the supporting planes, viewed from behind, are diagrammatically drawn, enables this to be perceived readily. According to it, the speed of the downward warped side is lessened, that is to say, the aëroplane describes a curve whose center lies on that side. Now, a vehicle must incline toward the inside of a curve if it is to maintain equilibrium. Therefore, to force the aëroplane into an opposite curve, the turning rudder must be used (Fig. 30). Thereby arises a new resistance, through which the speed of flight is reduced, and with the decrease of velocity the machine naturally descends, unless, in order to prevent its doing so, the angle of incidence of the supporting plane is increased. This means that the aviator must use the control for elevation. The simultaneous attention to all three elements, which Wright accomplishes by two levers, requires great alertness and skill. To the Wright Brothers, who have long experimented with gliders and worked several years in improving their aëroplane, the difficulties are less apparent than to their pupils. That must be the reason why, in spite of the excellent instruction, it has taken comparatively long for Wilbur Wright's first pupils to become educated.

This deficiency of the method for maintaining lateral stability may be obviated. It is accomplished by increasing the resistance on the inner side of the curve. In the simplest manner this is done by warping only one side of the main planes, that side which is to sink. The ends of the main planes must be so formed that by the curvature the resistance, and, therefore, the projection of the planes in the flying direction shall be increased as much as possible. The hinder edges of the main planes need not, therefore, under normal conditions, be drawn downward, but may lie in the direction of the path of flight. (Figs. 31 and 32 show this arrangement diagrammatically). It is evident that the resistance on the inner side of the curve is greater, so that even without action of the turning rudder, a tipping of the aëroplane is prevented.

As already remarked, it requires special practice, with only a single lever, to warp the main planes by a side movement and operate the turning rudder by a forward and backward movement. It is also common to operate the turning control by the lateral turning of a handwheel or a lever. If the rudder for turning is not swung about equally for its entire hight, but the lower edge more than the upper, a tipping moment is produced and the flying machine must incline inwardly in the curve that it describes. Still better is the effect, if not one, but two controls for turning are used, one at each exterior edge of the main planes. If the control for turning is united with the control for altitude, a displacement of the center of gravity may be produced at the same time, for in curving, a part of the rudder for elevation is displaced toward the inner side of the curve. By reason of the greater surface on that side, the friction of the air, and hence the resistance, is somewhat greater there.

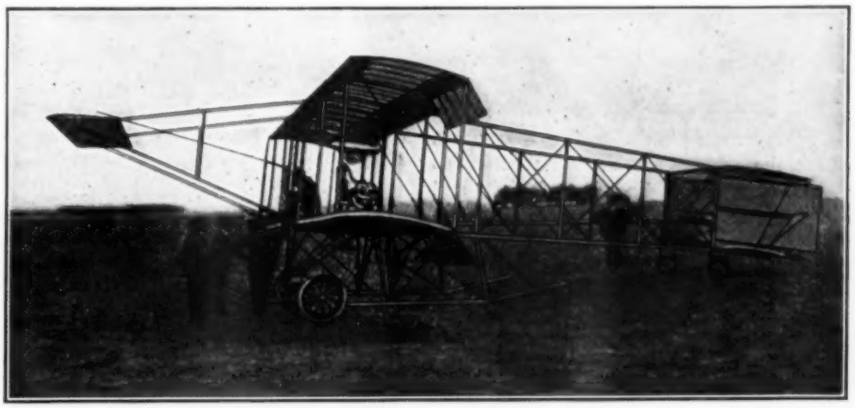


FIG. 42. LAST CONSTRUCTION OF FARMAN-VOISIN

For the operation of all controls, among which may be classed the appliance for giving lateral stability, an endeavor is made to perform all manœuvers by a steering wheel. In almost all land vehicles only one control is required. The operation of the airship's mechanism is easiest learned by starting from the methods in automobiles and bicycles, both of which are the natural predecessors of air automobiles, the aëroplanes.

In a certain sense this is the case with those flying machines which are most noteworthy after Wright's, namely, those of Voisin Brothers, whose double-deckers have become known through Farman and Delagrange, and in Berlin through Zipfel. Voisin employs a handwheel for steering, Fig. 35. The turning control is governed by twisting it; it is pulled toward the aviator for ascent and pushed away from him for descent. Voisin does not employ lateral stability controls operated by the aviator. This effect is accomplished automatically, by such methods as placing the center of gravity lower than in the Wright machine, for example, and by the slight upward curvature of the main planes. Vertical planes, formerly placed between the tail planes and later also between the main planes, fan the air when the machine tends to oscillate about its longitudinal axis; and together with the very broad main planes, they have a dampening effect (Figs. 36 and 37). The vertical planes have, however, the great disadvantage that in a side wind the aëroplane is driven further out of its course. Henry Farman has now in his Voisin double-decker (Figs. 38 and 42) employed steadying planes on both sides behind the main plane and revolvable around horizontal axes. If, for example, the flying machine inclines toward the left, the left steadying plane is depressed and the right one elevated. These planes are operated by a foot lever. The arrangement does not work as well as warping the main planes, because the fine gradations are lacking. Furthermore, the aëroplane of Voisin is not so flexible as that of Wright; it cannot, therefore, describe so narrow curves, which also is prevented by its great length. This, on the other hand, offers the advantage that the machine is very steady in the direction of flight and control for elevation requires less attention.

Comparing the two forms of construction, Wright's and Voisin's, the arrangement of the propeller must also be considered. Aside from the fact that Wright employs two screws and Voisin only one, the propeller shaft of Wright's airship is placed almost in the middle between the main planes—strictly speaking, a little above the center—while Voisin's is far below the center. Further, Voisin's propeller shaft lies in the direction of flight, and Wright's almost parallel to the imaginary chord of the curves of the main planes, so that the air current produced by the screws does not coincide with the path of flight. Since Voisin's point of power application lies below the center of resistance, the main planes, so long as the screw works, are inclined toward the direction of flight and the screw tends to increase the angle of incidence. Opposed to this is the influence of the tail planes, and so the correct angle of incidence of the main plane is automatically restored; the operation of the control for altitude, therefore, requiring less attention than Wright's.

Henry Farman has built a new aëroplane, which, aside from his alterations, etc., forms his third stage of development. The new Farman, Fig. 42, lies constructively between the Voisin and Wright models. The latter is suggested in the use of truck skids for landing. For starting, however, two wheels are employed on the front truck, beside which there are two smaller wheels on the frame of the tail planes. The arrangement for maintenance of lateral stability is the same as in Farman II, yet the movable planes at the rear, on both sides of the main planes, are furnished not only to the lower, but also the upper main plane. The vertical planes between the main planes are entirely lacking, only between the two tail planes are set vertical planes, and behind them are placed the two controls for turning. The control for altitude is put forward on a light triangular mounting, but further away from the main plane than in the Voisin construction. The arrangement of the screw is similar to Voisin's. Farman now uses the Wright wooden screw. As in the case of Voisin, the propeller shafts lie in the direction of flight, below the center of resistance, while in Wright's machine, as is known, the propeller shafts are somewhat above the center of resistance. The engine, a Vivinus motor of 50 horsepower, drives the two-bladed screw directly. The motor also suggests Wright's, since it has only four cylinders, water cooled. The water runs into the cooler, which is placed in front of the motor, and back to the motor, as a result of difference in temperature; a pump, therefore, being unnecessary. Before the cooler, which is built like an automobile cooler, and provided with a fan, is the seat of the aviator. He works the control for elevation with a hand lever at the right, the turning control being at the left, which again resembles Wright's method. The new Farman has the following approximate measurements: Breadth of main planes, 34 feet; length of aëroplane, 42 feet; diameter of propeller, 7½ feet. Of the starting wheels, it is noteworthy that the two inside ones on the skids have a less diameter than the two outside ones. Each large one has, in common with a small one, an axis, through whose displacement in the bearing on the skid the small or large wheel may be brought nearer to the skid, and in this manner the distance of the skids from the ground adjusted. Farman flies from the practice field at Chalons and has already ascended with his new aëroplane. Since the machine worked splendidly, further good performances are to be expected from Farman.

Emergency Use of Oxhydric Steel Cutting Process for Removing Wreckage

By E. F. Lake

One of the many uses to which gases under pressure can be used for cutting steel was forcibly illustrated in the recent boiler explosion at the Pabst brewery in Milwaukee, Wisconsin. This explosion took place at 4:30 on Monday morning, October 25, and completely wrecked the boiler house, which was a modern steel structure.

Four Munoz boilers, each of which had a 400-horsepower rated capacity, exploded at one time, burying one man in the ruins, fatally injuring another, and cutting off the steam supply from the entire plant. This latter would cause a great loss in

FIG. I. FIREMEN DEMOLISHING UNSAFE WALLS, ETC. SOON AFTER THE EXPLOSION

FIG. 2. MASS OF STEEL WORK THAT WAS CUT UP WITH OXHYDRIC TORCH FOR EASY REMOVAL

stock if steam could not be obtained in a few days.

Thus it was necessary to clear away the débris as quickly as possible, and the oxhydric cutting torch and apparatus, manufactured in Milwaukee, were brought into play to cut up the tangled masses of steel girders, tubing, boiler plates, boiler tubes, piping, etc. With it 16-inch steel I-beams, that it would take the better part of an hour to cut by any other method, were cut in a few minutes; coils of boiler tubes that it would take hours to sever by any other means, were quickly cut and carted away, and boiler plates were cut up in a comparatively short time in sizes suitable for hauling.

The boiler house which was wrecked had a frontage on the street of 49½ feet and was comparatively new, as it and the four boilers which exploded had been in use less than two years. In Figs. 1 and 2 are shown the wreckage after the explosion, and the tangled mass of twisted and

FIG. 3. STARTING TO CUT HOLES IN TANK FOR GRAPPLING HOOK

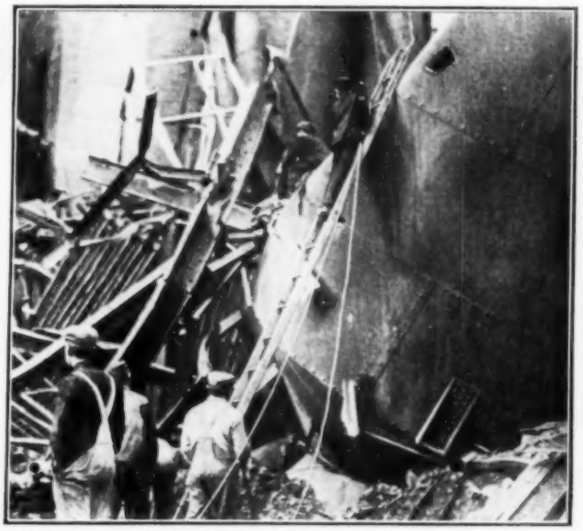


FIG. 4. CUTTING 16-INCH I-BEAMS. HOLE CUT IN TANK ALSO SHOWS

FIG. 5. CUTTING BOILER TUBES

bent structural steel and boiler material that had to be removed. These will give an idea of the usefulness of any method that could be employed to quickly separate the mass into sizes suitable for handling.

In Fig. 1 is shown the ruins just after the explosion, with the fireman searching for the man who was buried in the ruins, and demolishing dangerous walls, etc. The débris was piled 7 feet deep clear across the street and against the opposite building. To the right of Fig. 2 is shown the machine shop, the end of which was crushed in and filled with wreckage. The corner of the building shown to the left was the grain elevator, six stories high. The brick wall of this, on both sides, about on a line with the man standing on the top of the boiler tubes, was split in almost a straight perpendicular line, and the front part of the building pushed over on its foundation 35 inches.

In Fig. 3 is shown the Italian inventor of this process, Primo Lulli, as he is starting to cut a hole in the steel coal bunker that had turned bottom side up. Mr. Lulli is at present in Milwaukee for the purpose of getting the American company started. This bunker was filled with coal, and the hole was cut so the hook of a block and tackle could be inserted to haul it out into the street.

In Fig. 4 is shown the hole that was cut in the tank, while the operator is cutting off a 16-inch I-beam at the side, and the boy on the ladder is holding the rubber tubing which conducts the gases to the torch. This, by the way, is the last cut that the inventor made, as the tension on the bent beam in front was so great that it sprung over with force enough to loosen the wreckage on which the operator stood, causing him to fall among the débris and get bruised so badly that he had to be removed to his home, and could do nothing for several days.

This, by the way, was the second operator hurt, as the one preceding him, Hans Mueller, a Belgian who helped Mr. Lulli develop this process, had his foot crushed by a beam, that he was cutting off, falling on him.

In Fig. 5 is shown the operator of the oxhydric torch as he is cutting in two a series of boiler tubes, one end of which was fastened in the débris so tightly that it could not be removed without being cut in half. In the center of the picture is also shown the end of an I-beam that had been cut off, and the other beam which stretches clear across the picture was also cut in two.

The use of this process for the cutting of metals in emergency cases of this kind was so practically demonstrated that it proved to be the best possible help for any similar job. The cuts made were so numerous that it is impossible to enumerate them all, but wherever an end of steel shows in Figs. 2, 3 and 4 it illustrates a few of the cuts that were made.

An Easy Method of Lettering

By Ralph W. Davis

It is generally agreed that an elaborate title, on a drawing intended solely for shop use, is an undesirable expense, but it often happens that a drawing which is to be sent outside requires a title of neat and dignified appearance which assists in making a favorable impression.

The solid block letter seems to have the desired qualities but considerable time is required to lay out and fill in such letters, which makes the title rather expensive, and in order to reduce this expense and still get the result I find the use of cut letters all that can be desired. These letters (made by Dennison, the tag man) are sold in sizes from one inch high down to about 3/16 inch; they are cut from black opaque paper, with gummed backs. Having decided on the wording of the title, it is only necessary to pick out a letter, moisten it and press it in place on the tracing. The resulting blueprint will be clear cut and business like. The letters adhere well to the cloth, but, when so desired, may be easily removed.

The letters are very useful for many other purposes in a drafting room, such as lettering files and records and they give a uniform appearance that is far superior to free hand efforts.

A Neat and Efficient Repair for Metal Articles

By Chas. C. Klein

A jobbing machine shop is often called upon to repair a broken part of a machine in such a way that the parts will remain in proper position, have firmness enough for ordinary use, and be free from projections.

While the principle illustrated here is applicable to the mending of a great

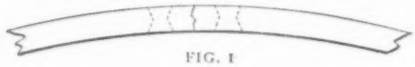


FIG. 1

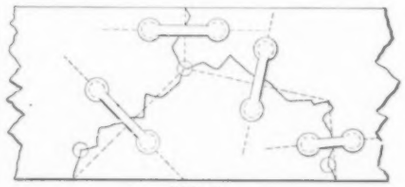


FIG. 2 *American Machinist, N.Y.*

A NEAT REPAIR FOR METAL ARTICLES

variety of broken articles, it is especially to be commended for such work as does not call for the original strength, but rather, for a neat piece of work, which will be, after mending, as smooth as it was before the break.

Method of Procedure

Let us take the piece shown in Figs. 1 and 2 for an example. It is not only cracked all the way across but a piece has been knocked out. The first step is to introduce the piece broken out with as little injury to its edges as possible. If the break follows approximately a straight line as shown at the left and at the upper edge of Fig. 2, join the ends of the break by a straight line and draw one or more lines perpendicular to it. If the length of the crack is short, one line near the center of its length will be sufficient; if long, several lines may be drawn dividing the length of the crack approximately into equal parts. When the general line of the crack has a decided angle in it, as shown on the right of Fig. 2, lines should be drawn from the ends of the crack to the apex of the angle and cross lines should be drawn as before. A little distance away from the crack, which may be ¼ inch to one inch according to the size of the job, drill holes upon the cross lines and countersink them very deeply but with a very slight taper. It is not necessary to pay any attention to the parallelism of the two holes. If they are out of line with each other, it is rather a benefit, as the discrepancy will have the same effect as a countersink in the holes. The two holes are now connected by a rectangular slot which may also be countersunk. Particular attention should be paid to the perfect matching of the slot where it crosses the crack, as want of accuracy here will impair the strength of the job. The corners at the junction of the round holes with the rectangular slots should be slightly rounded in order that a fillet may be formed on the soft metal link which is to be cast in the slot, thus adding largely to its strength.

When everything is ready, take a piece of paper, preferably asbestos, and lay it upon a cake of soft putty or fire clay, the whole supported by a light piece of board and clamped firmly to the under side of the piece to be repaired. On the upper side make a little dam of putty around each pair of holes or around all of them. Now pour melted metal into the link-shaped openings and dress off the casting level with the surface. In cooling, the links will shrink enough to pull the crack tightly together and will hold the pieces with a force equal to the strength of the metal that has been poured.

It is of great importance to use a tough metal to form the links. Many of the modern so-called "babbitt metals," being composed largely of lead and antimony, have such a low tensile strength that the links will crack in cooling and shrinking and will thus impair the bond they are intended to furnish. Such cracks, although often invisible to the naked eye, may render the entire labor useless. Genuine babbitt metal is very suitable for this purpose, but when extra strength is desired an alloy of equal parts of tin and spelter will be found excellent.

When the broken part is a pulley rim or other revolving article and is therefore subject to centrifugal force, care must be exercised to make sure that the joint will not fly apart. When the break does not extend over too many degrees and the edge is not broken into more than one piece, holes may be drilled at the ends of the cracks, as shown in Fig. 2. Countersink there holes shallow, tap them and screw iron or steel plugs into them, which should be slightly riveted on both sides.

Made with care and under favorable circumstances, cracks have been drawn so closely together by this method, that they could not be detected without a microscope, and the only indication of a break having occurred at that point was in the different color of the links from that of the surrounding metal.

Practical Letters from Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

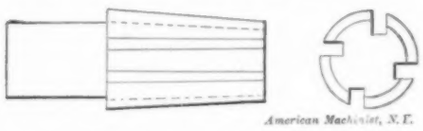
Mandrel for Threading Inserted Blades for Taps

The cut shown of a mandrel for turning and threading inserted pipe-tap blades is a greater saver of time and money than would appear at first glance.

I made this to do away with backing off of the blades, also to do more at one setting of the lathe than could be done by using the regular tap.

You will notice that the amount the blades are set off center determines the amount of clearance.

This mandrel could be used to good advantage for any kind of inserted cutter blades when wanted in quantities and no backing-off lathe was at hand.



MANDREL FOR INSERTED BLADES OF TAPS

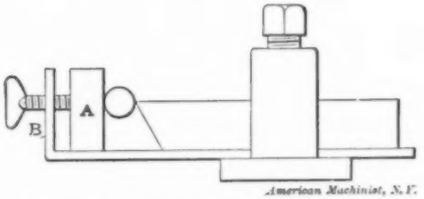
The tap blades were for Pratt & Whitney pipe taps and made in large quantities. They have a threaded collar so that each blade will come to the proper position and pitch. The blades are driven into the mandrel. They can also be fastened in with the taper wedge and screw used by many on inserted reamers.

THOMAS A. WALLACE.

Philadelphia, Penn.

Cutting a Thread on Slender Work without a Steady Rest

The job was to cut a thread on a long, slender piece of steel and there was no following rest. I tried several ways and finally I hit on the following: I took a piece of band steel *B* 3/16 inch thick and 1 inch wide, cut it down to fit in the tool post under the tool, allowing one end full width about 1½ inches long which I bent at a right angle and drilled and tapped for a ¼-inch screw. Then I got a piece of hard wood *A* and put it against the work and turned the screw. This device could be used to good advantage on many other jobs.



CUTTING A THREAD ON SLENDER WORK

Central Falls, N. Y. W. C. BAKER.

[It seems to us that there might be some tendency for the work to "climb" on top of the tool. A small toe either fastened to the tool or to the block of wood would prevent this.—ED.]

Making Jigs and Fixtures

It was essential that the parts machined in these jigs and fixtures should be as accurate as possible. Considerable care and thought was therefore given to the methods of making them, and also to obtaining the different dimensions required to enable the jigs to be machined.

I believe that the conditions to be met and the means adopted in the manufacture of these jigs are such as are not commonly met with in most shops. The results obtained were in every way satisfactory and doubtless the methods here shown could be used to advantage on other classes of work.

Fig. 1 is a lathe fixture for boring a bracket and is located on the face plate by hub *a*. Faces *b b'*, *c* and *d* were first machined, faces *c* and *d* being machined on an angular packing plate that was correct for the angle 6 degrees 51 minutes.

To bore the recess for the hub a button was located in the correct position measuring from a half-inch test bar as shown and using the dimensions given. The job was then taken to the lathe, put on an angle plate on face *b b'* and set by means of an indicator.

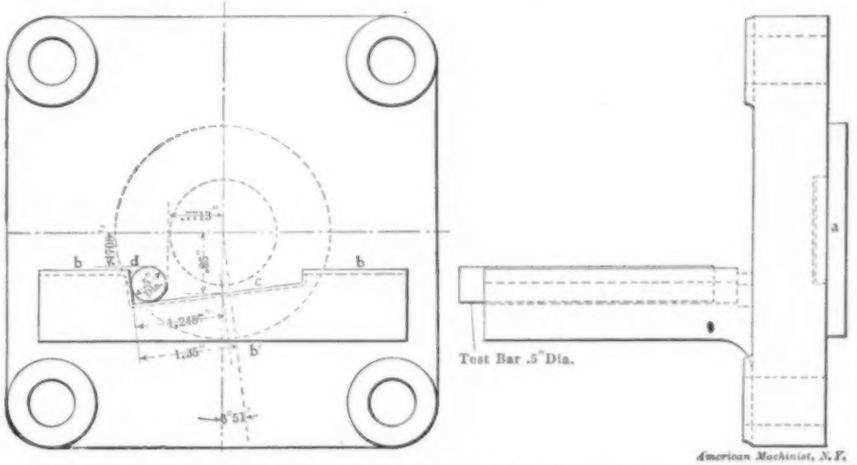


FIG. 1. LOCATING THE CENTER OF A FACE-PLATE FIXTURE

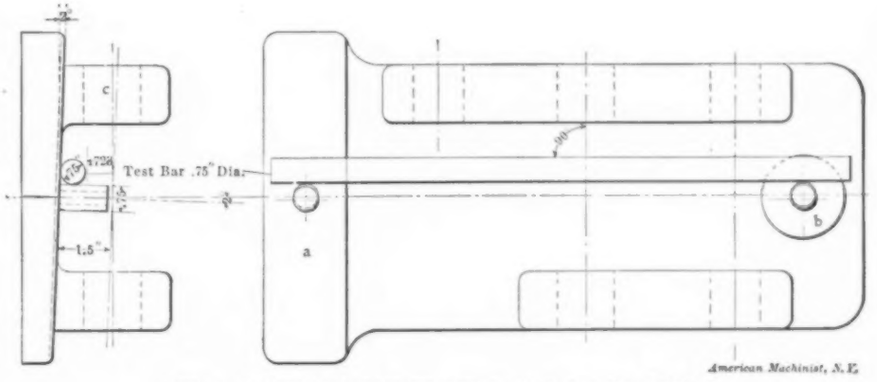


FIG. 2. LOCATING A PAIR OF STUDS ON A BORING FIXTURE

Fig. 2 is a boring fixture. The job is located on studs, not shown in the sketch. The dimension 1.5 inch is at 90 degrees to the 2-degree inclined face of the fixture and to get this correct it was essential that the position of the locating studs along this inclined face should be correct. After boring, faces *a* and *b* were machined at an angle of 2 degrees with the base.

Two buttons 0.75 inch diameter were then located, using a 0.75-inch test bar as shown, the button being moved along the inclined faces until the test bar was at right angle with the holes already bored and the distance from the top of the test bar to the center of hole *c* correct to the dimension given.

The fixture was then laid on a 2-degree angle plate and bored on the milling machine, for the holes to receive the locating studs.

Fig. 3 shows a boring fixture for a bracket. As will be seen from the sketch, all the dimensions were given from point *A* on the inclined face *b*. The face is at an angle of 23 degrees with the base, locating face *c* being also at an angle of 14 degrees with the center line *a b*. A ¾-inch steel ball was soldered to a plate, and secured to the face of the fixture as shown, the center of the ball being brought directly over the point *A*. The distance from the center of the ball to the center line *a b* was then found by calculation, the hight of ball from the face of the fixture and the distance from face *c* to the center of the ball, on an angle of 14 degrees with center line *a b*, having to be taken into consideration.

Face *d*, having been previously milled, the loose bushing *e* was used as a button and clamped to face *d*. The button was then located in its correct position in relation to the ¾-inch steel ball both vertically and horizontally.

As an additional check the distance from the top of a 1-inch diameter test bar to the center of the hole to be bored was found by calculation, the test bar being laid along face *b* and parallel with face *c* as shown.

Fig. 4 is a jig located in position on the piece to be drilled by the tongue *a*. The position of this tongue must be correct from point *A*. The method used was similar to the one followed in the other examples.

The slot for the tongue was made 0.25 inch deep, and a 0.25-inch test bar used as indicated in the sketch, the distance from face *c* being calculated. The four holes in face *d* were bored first in the correct position with the tongue slot. The holes in face *c* were next bored, working from the 0.25 test bar. The boring was done on the horizontal boring machine.

Coventry, Eng. W. L. WATERHOUSE.

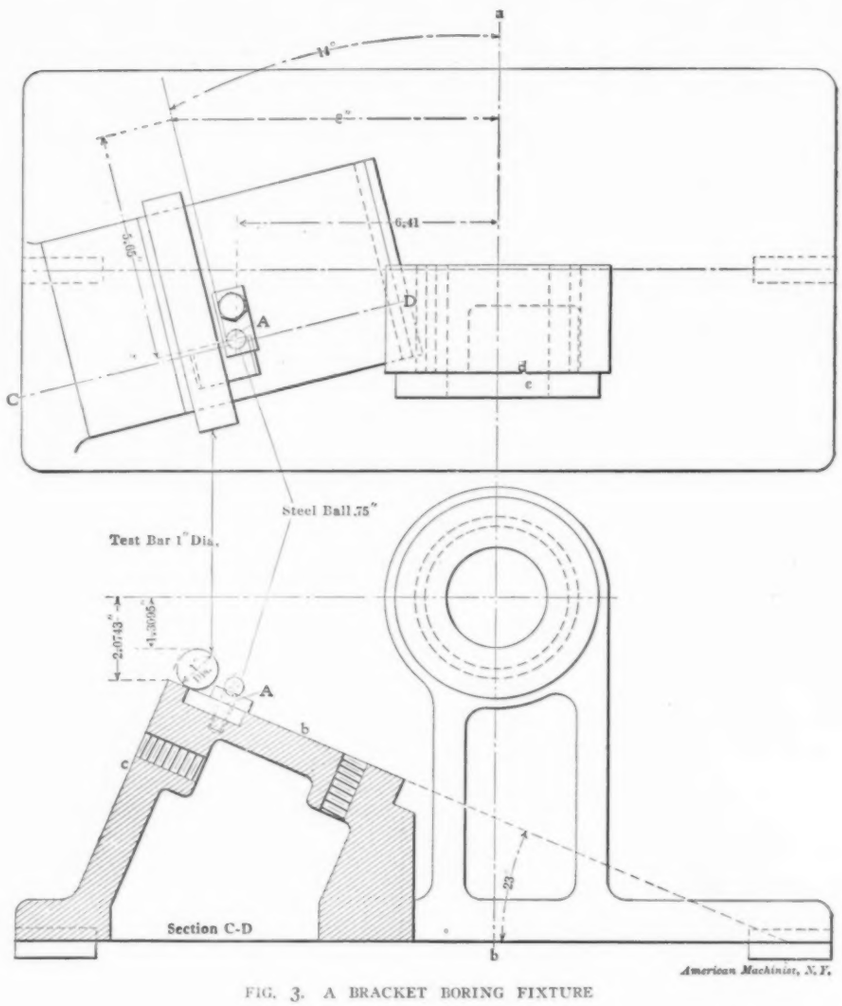


FIG. 3. A BRACKET BORING FIXTURE

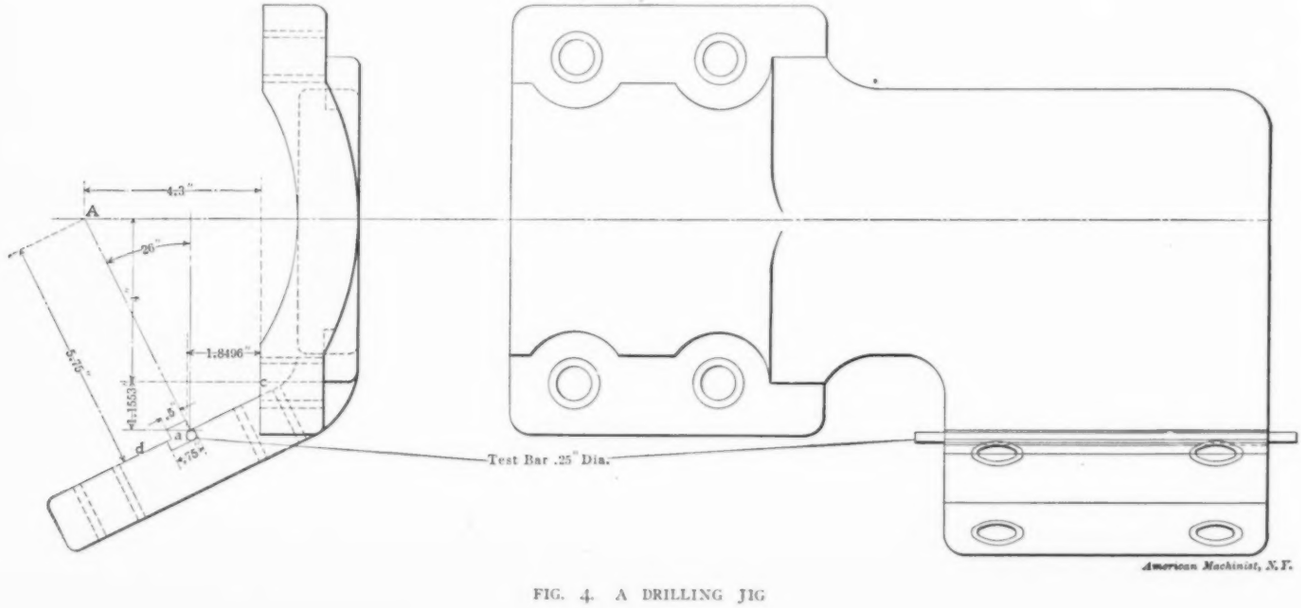
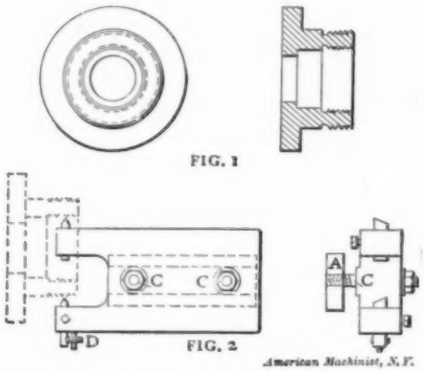


FIG. 4. A DRILLING JIG

Simultaneous Internal and External Threading

Fig. 1 shows a steel casting finished all over. The internal and external threads are of the same pitch, 14 per inch.

The threading operations are done simultaneously. Fig. 2 shows the tool holder clamped in the slide rest of the lathe, in place of the tool post, by the block *A* and two studs *C C*. The inside thread tool



SIMULTANEOUS INTERNAL AND EXTERNAL THREADING

does its cutting upside down and is held by the set screw as shown.

The outside tool is adjusted to correspond to the inside tool by means of the slot in the tool and the nurled nut *D* and is held by the set screw as shown.

Detroit, Mich. CY. PRESS.

[We have used this same rig for boring and turning but not for threading.—ED.]

Using Square and Hexagon Stock in Screw Machines

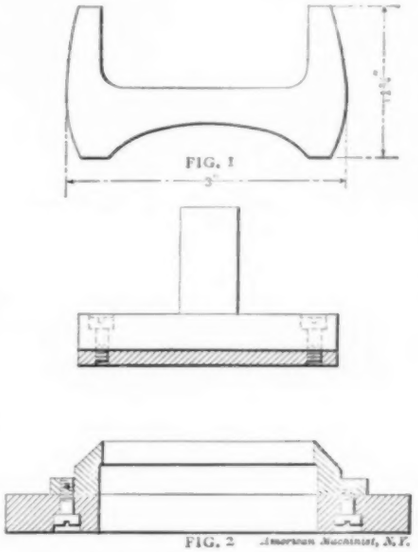
Most of us in operating either hand or automatic screw machines on square or hexagon stock have experienced trouble when putting in a bar of stock to get the corners of the stock in line with the corner of the chuck, or in the automatic, in line with the feed finger. Recently I saw a very easy and satisfactory solution for this difficulty which is to drive in the rear end of the spindle, or of the feed tube a bushing with a hole splined out the same as the chuck. After this bushing is once put in line it is no more trouble to put in a bar of hexagon or square stock than round stock. The gain in time and convenience is more than enough to offset the added expense of these bushings.

The above method for automatic machines applies only to those which have the feed tubes keyed to the spindles, as otherwise the rod would not come in line with the chuck. On this style of machine a feed finger with a round hole the size of stock across the corners is used by some parties successfully. On very small stock it might mar the corners, but otherwise it is successful. The best method, however, is to have the feed tube keyed to the spindle, so both are sure to revolve in unison, and spline the feed finger and the bushing for the rear end as mentioned above.

Boston, Mass. J. O. SURFACE.

Punching Fiber

I have recently had some experience with the punching of red fiber, such as used for insulating purposes in the electrical business, and found it a more difficult job than expected. We required large numbers of articles as shown in Fig. 1, ¼ inch thick. We had been making them from fiber sheet cut up into pieces and a number clamped together and ma-



THE WORK AND THE DIE

chined to the required shape in the shaping machine.

As this was a slow and expensive operation it occurred to me that it might be possible to punch them. To find the result of punching fiber we used a tool already in existence but designed for punching sheet steel. The blank produced was anything but satisfactory, the sides for the lower half the thickness being very rough and broken, but the first half of the thickness fairly smooth. On thinner material, about ⅛ inch thick, the result was much better and on 1/16-inch material the blank produced was all that could be desired. We made several alterations to this tool, such as varying the clearance between the punch and die and varying the angle at the cutting edge, etc., but in no case was the result satisfactory on ¼-inch material. Thinking that we might get better results if the fiber was in a drier condition we placed a piece in an oven until dry but in operation we found that it crumbled badly under the punch. We also experimented with the fiber containing various amounts of moisture and these experiments seemed to prove that the best results would be obtained when the material was in a condition containing only a certain amount of moisture. We have obtained the best result so far by producing the blank in two operations. The tools for the first operation are designed the same as for operating upon steel except that more clearance is allowed between the punch and die and the blank produced has ⅛ inch allowed all round for finishing, owing to the edges coming out rough and broken from this tool. For the second operation a tool is used as shown in Fig. 2. The die can be made either in one piece or in segments. The punch consists of a brass or copper pad secured to a holder as shown. In operation the rough blank is located in position on the die and the punch pad in descending is so set that the sharp edges of the die enter about 1/32 inch into the pad, the ⅛ inch of scrap allowed all round for finishing breaking away clear and the finished blank falling through the hole in the press body.

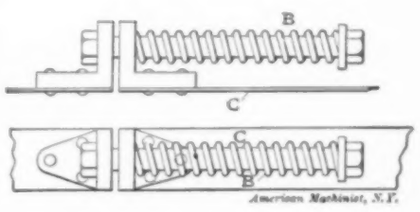
The disadvantage of this die is that it cannot be ground owing to the shape of the blank, but dies for circular or square blanks, etc., have not this disadvantage, as they can easily be ground.

Perhaps some readers who have had experience with the punching of thick fiber may give their experience.

Sheffield, England. MARK DALE.

An Expansion Clamp

For the purposes of internal repairs the shell of our large upright boiler is made in sections and necessarily the lagging is in sections also. In order to prevent the lagging becoming loose by frequent handling the clamp shown in the sketch was used to hold it in place. It was necessary that the steel bands *C* should not cut the lagging when the boilers are hot and also



AN EXPANSION CLAMP

they must not become too loose when the boilers are cold. For this reason it was necessary to have an expansion clamp.

The cut needs no explanation further than to say that the brass spring *B* was designed to close, the required 3 inches, by a force of 50 pounds, thus not injuring the lagging, but keeping it well in place.

Preston, Cuba. R. A. ANDERSON.

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

Notes and Comments on Industrial Training

From the letter of "Entropy," the action of the Machine Trades Association, your editorials, etc., I gather that industrial or technical training or education of metal-working and erecting mechanics is a matter of urgent concern. Personally, I am rather pleased to note this state of things, as it would appear to denote that a certain class of "business" men in the States are, in due course, "hoist with their own petard." I have noticed during the course of 15 or 20 years from personal converse with various classes of engineers from the States, and observation of current American technical journals, the vogue of several phases of, and modes of thought on, the above topic.

Perhaps a few comments may not be tedious. In the first noticeable period, industrial and commercial conditions were such that a number of alert native and imported European mechanics had plenty of scope for the expression of their individuality on mechanical products, and the ever present demand for all classes of work—a large proportion of which was imported from Great Britain—allowed of these men being well appreciated by employers whose function was largely exercised in the form of acting as co-worker rather than as a class socially distinct from their employees. For some time, the supply of European workers, rather narrowly trained perhaps, but still competent in their particular department, and in the States better able than in their original environment to enlarge the field of their experience, coupled with the free and easy style of entrance of native men or boys into the trade, met all requirements. Later, the apparent ease with which men or boys moved from one branch of the trade to another and managed to hold their posts seemed to create an impression that the superior intelligence and adaptability of American labor compared with what I have seen described in print as the "pauper" labor of Europe, rendered unnecessary any period of routine servitude or training. In fact, it was somewhat degrading for any self-respecting youth to submit to be engaged in one branch of the trade, or to be kept under one employer for a term of years on a variety of work, even previous to expecting to receive the full current wages.

About contemporary with this state of things was the idea that association with others in the same calling, for mutual assistance and benefit, would never be called for, owing to the peculiar freedom enjoyed under American condition. Then, somewhat later on, the larger employment of automatic machinery and the utilization of unskilled or semi-skilled adults in conjunction with emigrant skilled labor appeared a pretty satisfactory solution of the labor question. Now since the slump of 1907-8 the intervening absorption of otherwise discarded labor by the automobile industry, other branches of engineering find themselves in a position bearing an uncommon resemblance to starting *de novo* and my impression is that the experience will, by the time they feel their feet again, do those concerned all the good in the world. From the available evidence it would appear that in the States an actual shortage of reasonably competent men prevails or is imminent anyhow; that is how I size things up.

Plenty of Labor in Europe

On this side of the Atlantic an opposite state of things seems the rule. Things certainly are slack, but even when things mend there appears little likelihood of any serious lack of reasonably competent labor. Further, any number of boys can be obtained as apprentices. As regards technically trained men, judging by the rate of compensation offered to those desired in the engineering journals' advertising columns, there appears three or four well qualified men on offer for every post needing filling. Proportionally, the salary offered to designing and administrative ability is lower than that offered to the possessor of routine workshop experience only. For instance, the following "ads" appeared in close juxtaposition in *Engineering* in June last. "Wanted, Engineer, Draftsman-in-charge, (age 27). Salary $12.50 weekly. Requirements, thorough working knowledge of mechanical principles, ability for original design, first-class shop experience—no application considered without showing evidence of suitability."

In the other case the City of Oxford wanted "first-class mechanic to take charge of a waterworks pumping station; Worthington and rotary pumping engines. Salary $12.50 weekly, *with house, coal and gas free.*" So that the mechanic or engine tender would obtain an equivalent of probably $2.50 more than the technical trained man. Of course, I am not contending that the mechanic was overpaid.

Another recent advertisement calls for a "*Working* foreman patternmaker for one of the largest textile machine works in Lancashire, who has specialized on cotton machinery, must be an uptodate man, used to the control of men, none but non-trade unionism will be entertained. Apply, stating experience, *wages* required etc." The italics are mine. In the last mentioned instance the man appears to be expected to work manually at his trade as well as superintend his men, and he will only receive *wages*, not salary. I doubt if the wages purposed to be bestowed will amount to the sum mentioned in the two previous examples. If such is all that a concern of such standing has to offer at date, it is not very encouraging to technically trained aspirants. On the whole, there would appear evidence of the recent superabundant supply having resulted in a tendency to "sweat" the more brainy type of ability. No doubt many employers could give instances where endeavors to better the general conditions of employees have met with scant appreciation, but, speaking broadly, my impression is that British employers have an immense reserve of artisan, designing and administrative ability, which, if they are in general, capable of appreciating at its value and appropriately handling will enable this country to hold its own industrially, long after contemporary pessimists have ceased croaking.

Industrial Training

Returning to Entropy's favorite subject—organized municipal or locality effort in the way of day or evening classes for teaching general science subjects and the technology of a wide range of crafts—decided progress has been made, especially in the larger Lancashire towns and in London. In Manchester especially, from primary to university education an approximated graded sequence is provided. These facilities are increasingly appreciated, especially by foreigners, as regards the highest branches of technology, French, German, Japanese, Chinese, East Indians and Colonials being enrolled and proving most diligent students. In some districts the facilities are in advance of the number of students entering, for instance, at Keighley, Yorkshire, efforts are being made to popularize the course. A number of local concerns grant scholarships to young employees who prove their fitness by passing suitable examinations.

The scholarship takes the form of payment of fees and the cost of necessary books, etc. Preliminary instruction in all

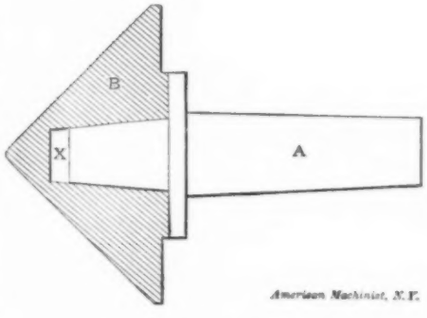
the necessary subjects is available at low cost—toward which the firm contributes, and the students are not allowed to present themselves haphazard for entrance to technological subjects.

Here is a source of supply for those American employers who cannot obtain boys at all. For boys similarly trained in chemistry and dyeing departments there is a good demand. In the cotton spinning and weaving departments good results are obtained scholastically, but the cash gains to students, especially the evening students who are often very anxious to learn all possible, are mostly of a microscopical character for some time after their graduation. It must be remembered that these latter students are working practically at their trade during the day. In fact it would seem that plenty of facilities for learning principles are available and if anything is wanted more than another it is workshop training pure and simple; so that a boy can be taught, leaving, if advisable, principles altogether out of question, how to actually *perform* to the best *pecuniary* advantage the everyday workshop operations, and thus pursue the craftsmanship on which all progress chiefly depends.

Manchester, England. JAMES VOSE.

Correcting an Error in a Crank Shaft

A large crank shaft ordered from an outside concern, was found on delivery to be 1 inch longer at the center bearing than it had been ordered. The manufacturers were willing to correct their error, but



A PIPE CENTER

our forge-shop foreman didn't care to wait. Heating the shaft sufficiently at *A* he rushed it over to the big lathe (where provision had been made to preserve correct alinement) and putting it on centers, screwed up the tailstock, whereupon the shaft took the form indicated by the full lines at *A*. It was then worked to correct size.

H. THOMAS CLARK.

Rochester, N. Y.

Entropy's System of Paying for Work Discussed in the Shop

"Hello, boys; is there anything new?"

A lot of the shop fellows were resting and waiting for 1 o'clock.

"Sure there is something new. Haint you been reading your MACHINIST regular? If you have, you know that Entropy has got out a new system of paying for work. If there is anything needed just now it is some way to pay for work. Lots of us would be satisfied with most any old way if only the work was around so plenty that it used up all the systems to take care of all of it."

"Say, fellows, I can't just get it through me what it is that Entropy is driving at. I always like to read his stuff, and thought that he was a pretty decent sort of a chap, but the way he starts out you would think he never associated with honest men who worked for a living. Maybe he means it for sarcasm and we are not posted enough to catch on."

"Say, now, Bob, I don't know how he means it, but I hope that they will get to trying that bidding for jobs and put them all up. I know one job that I would take dirt cheap. There is one foreman in this town that would lose part of his job. He flies all to pieces and yells and curses and acts like a crazy man. He took one spell like that at me, and I don't know yet what it was about, and I'm not likely to find out either, for I don't work there now, but I would pay a premium to be boss for a few minutes while he had to work for me. He would never forget some of the things that I would say and do to him, and they would not be any worse than what I heard him say and saw him do to others, either."

"Pete will be boosting for the Entropy plan now. He thinks that he sees a chance to get to be one of the bosses. Who are you going to get to go on your bond when you put in your bid, Petey?"

"But honest, now, boys, what do you think of these schemes for paying for work," broke in Seymore. "Here, Rich, you worked in a shop where they used the premium plan. How did it work out?"

"It worked out all right on the jobs that they had going. A man had to get out quite a lot of work to make any extra money at it, but then they made everything handy so that he had a fair chance to do it. A man could do a good day's work anywhere if they rigged up like that for him.

"Don't you know? It is funny. Some fellow is running a shop with the notion that he is making money by making the men work without anything to work with, and that sort of a fellow goes around with the idea that the men are trying to stick him, and more than likely they are, for he lays awake nights trying to figure out ways to stick them. By and by along comes a long-headed fellow with a wonderful system and talks him into it and that fellow puts in his system, and while he is doing it he fixes up things so that men can do a day's work. He don't get the cheapest supplies that he can find and then not give the men half enough of them, but he gets good stuff and lets the men have all that they need. Maybe it is the premium system of paying the men that he works the shop into, and while he is running it the men make good money, and so does the shop, and everything is lovely. When he goes away and the first fellow tries to run things everything gets all 'balled up.' Of course they do, system or no system. He is too narrow between the eyes." Seymore reached for the bag of "Five Brothers" that he saw in his neighbor's pocket.

"I guess that is about right. I worked in a place once where it took more time to get a bolt or a washer than what they cost. It was hard to see how they figured things. They had nice buildings, and up-todate machinery, but right there it ended. The only man in the shop who didn't have to lock up his lathe tools at night was the fellow that ran the bull lathe, and his tools would not fit the tool post of any of the other lathes. A new man who came to work there had an awful time of it. The boss would give him enough stuff to do the first job given him and after that he had to shift for himself. The way to get more stuff was to steal it from some other fellow. You didn't find any stray bolts or chisels lying around loose in that shop. One day I went out to the blacksmith shop to have a tool tempered and before I got back a fellow had come along and stole a piece out of my belt. The boss had given him a hurry-up job and told him which lathe to do it on. When the man got ready to start up he found that part of his belt was gone and the boss was not in sight. He asked one of the other fellows where he should go to get a piece of belt and the fellow said it would be all right to go and take a piece from any of the machines that were not in use. I knew better than to bother the boss, and I had been in the shop long enough to know which machines did not have a man running them as a regular thing so I got another piece the same way that he had gotten the piece that he needed. You could hardly expect a man to fall over himself trying to get out a big day's work in a shop like that, could you?"

"But see here, now. Go back to Entropy's ideas. What do you think of his statement about the man who works by the day? It surely indicates that there are a lot of dishonest men in the world, according to his notions, for if his statements mean anything they mean that the average man is not to be trusted—here, you, keep your hand away from that tobacco!—and so the stores put in cash registers and the shops put in time clocks, and the cashier lights out with the bank's money in spite of his bond, and the

burglar does his best to help himself. With just one decent fellow out of ten no wonder that a new system is needed. I can't tell how he got the proportion, but, so as to have a starting point, suppose we let on that it is just as he says it is. I never thought that the bosses and the office men, the school teachers, the college professors and the rest of the world outside of the machine shops were as tough as that shows them up to be. They must be tough, though, because most of the men I know in the shops are not the kind of men that Entropy tells about, so that most all of the rest of the world must be to keep the average right.

"It is time that we did some planning to make them brace up and do as they should do. I sent my boy away to college and there is not any doubt that the premium system should have been applied to the professors, and they should not have been paid except for the ideas which they got into the students' heads. That is to say, they should have been paid for the useful ideas only. If that was the practice right along, we would not hear so much about the products of the colleges being so useless in the shops. It would surprise you to know what a lot of useless things they make a youngster learn for the privilege of learning some useful things. Perhaps it would not be right to call such things 'soldiering' on the kids. We all have our own ideas about things."

"Hey, Barney, what do you think about it?"

"I don't mind their new systems or anything of that kind. A man has a right to get up something if he wants to and is smart enough, but it makes me mad when they say they did it because working men are not honest. I got a job here and the boss tells me what to do and how he wants me to do it, and if I don't do as much as he thinks I ought to do he tells me so very quick, and if I can't or won't come up to his mark he fires me. The boss that don't know what a day's work is, is the one who is the hardest to please. Now, if the boss spends his time trying to figure out some way to make me do more work for less money why should he say that I am not honest because I don't bite. I don't say that he is dishonest because he tries to figure that way, but just suppose that I kept figuring how to get more money for less work right along, what would he say about me?

"He hired me to keep the shop clean, and he said that he would pay me $1.60 a day, and I dug right in and I think that I earned every cent of it. By and by he came around and said that he was going to pay me $1.75 a day for the work because I was the best man he had ever had on the job and because I stuck to it, and after that I just dug in harder than ever for I know a good boss just as well as anyone does.

"Suppose, now, that I was sweeping this shop by the piece. Got so much every time that I swept it, and as soon as I got it swept that I could start in and do it over and over again just as often as I could. I would be getting push brooms and all sorts of improved brooms to try to get over oftener, and try sweeping crossways instead of lengthways, and maybe I would get up a broom with wheels and a little gasolene engine. That would be all right just so that the sweeping was done right. The boss isn't paying me for that kind of thinking now. My kind of thinking is to think how he told me he wanted me to do my work, and his kind is to think how he wants it done. *My* job is to do as he tells me with the tools that he gives me, and *his* job is to tell me.

"Maybe this Entropy that you are talking about never did have a job of sweeping the floor, and maybe if he did get one he would try to not do much, but maybe he just talked that way because he forgot that we are just 'folks' like he and the rest of his acquaintances. Working by the day in a machine shop don't alter that. If you want to judge the other fellow just think what you would do in his place. Mostly he will not do any worse than that, anyhow. When you are doing it you had better use your own best streaks to compare him with and not your worst ones."

"Barney, if your head was as strong as your back you would be a great man. There goes the whistle. Come over and give me a lift."

Oil City, Penn. W. OSBORNE.

A Nut Lock

While the lock nut described by Mr. Lowry, on page 670, seems simple and effective at first sight, there are several points about it that would render it impractical for commercial use.

I should like to know how Mr. Lowry proposes to broach or otherwise shape a tapered hole of the peculiar cross section required. It would also be interesting to know how he would manufacture the ridged taper pin which "locks" the nut, on a large scale. The devising of a method of locating the tapered hole in the nut so that the projecting ridge of the taper pin would fit into the bottom of the thread of the bolt would also present some difficulties.

Not only would such a lock nut be difficult to manufacture, but the principle upon which it is based is one which would cause a continual strain to be put upon the nut, and would be very likely to break it, if the taper pin were forced in at all hard.

With these reasons, and in view of the fact that there are a number of cheap and successful lock nuts on the market, it seems to me that the one proposed by Mr. Lowry would be of little practical value, either in point of cheapness or on account of any other advantage gained by its use.

Wilkes-Barre, Penn. F. A. STRAUSS.

[It seems to us that a plain taper reamed hole is all that is necessary as far as the hole is concerned, and a plain taper pin with an angle machined along one side would do for the pin.—ED.]

Strength of Flat Plates Supported at the Edges

The statement of Mr. Wise in the last paragraph of his article on the "Strength of Rectangular Plates Supported at the Edges" on page 124 requires to be set right.

For more than 15 years tests have been made with plates of all kinds of shapes and with various ways of fastening at their edges by the well known Professor Bach. I was several times present at these tests about eight years ago.

As the subject is of great general interest and much importance in everyday engineering calculations, I present an accompanying table of the results of all the cases which were studied by Grashof and Bach. Most of the formulas and their coefficients were controlled by the tests of Bach. I have frequently applied the one or the other of these formulas to engineering problems and as yet have never had a failure or breakdown by using them.

The modulus of elasticity is marked E; p is the load in pounds per square inch for a load uniformly distributed over a plate; P is the total load in pounds acting as shown in the diagrams, either at a point or over an indicated area.

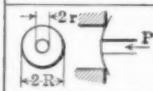
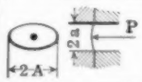
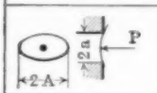
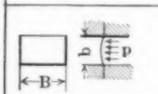
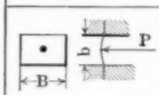
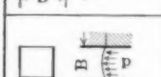
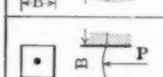
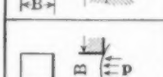
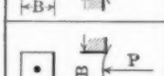
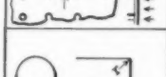
Referring to the table the dimensions are in inches and the loads in pounds. For steel plates whose fastenings are elastic enough to give equal stresses at the center (third case) and at the circumference (first case) α may be reduced to 0.33—0.38.

The table gives formulas for plates supported at the edges and built in, in shape round, elliptical, rectangular and square, made of cast iron (C.I.) and steel (stl.) which are loaded both uniformly and at a point. For round plates the force is acting uniformly over a surface of radius r; for $r = o$ the load is acting on one point at the center.

Regarding the accuracy of the above formulas the tests of Bach have demonstrated that the strength of the plates depends much on the fastening or support at the edges, the spacing of the bolts (for flanges, etc.) the forces exerted by those bolts (making a more or less elastic joint), the gaskets, the character of the tightening surfaces, etc.

There are numerous cases of ring-shaped plates treated in a scientific way by Mr. Enslin, but the formulas aimed at are extremely complicated and, considering the rare occurrence of these cases in engineering practice are also of minor interest.

Paris, France. MESSNER.

Shape and Fastening of Plate	Maximum Fibre Stress Due to Bending, s	Coefficients	Deflection d in Center of Plate	Coefficients	Remarks
	$s=\phi \frac{R^2}{t^2} p$	Cast Iron $\phi=0.8$ Steel $\phi=0.45-0.5$	$d=\psi \frac{R^4}{t^3} \times \frac{p}{E}$	Cast Iron $\psi=0.17$	For Cast Iron Maximum s in Center, for Steel at Circumference.
	$s=0.438 \frac{P}{t^2} \log \frac{R}{r}$		$d=0.22 \frac{R^2}{t^3} \frac{P}{E}$		Use Naperian Logarithm for s.
	$s=\phi \frac{R^2}{t^2} p$	Cast Iron $\phi=1.2$ Steel $\phi=0.67-0.75$	$d=\psi \frac{R^4}{t^3} \times \frac{p}{E}$	Cast Iron $\psi=0.6$	Maximum s in Center.
	$s=\phi \left(1-\frac{2r}{3R}\right) \frac{P}{t^2}$	Cast Iron $\phi=1.44$	$d=\psi \frac{R^2}{t^3} \frac{P}{E}$	Cast Iron $\psi=0.4-0.5$	
	$s=\phi \frac{a^2}{t^2} \frac{p}{1+n^2}$	Cast Iron $\phi=1.34$ Steel $\phi=0.84$			$n=\frac{a}{A}$ ϕ for Steel Estimated
	$s=\phi \frac{8+4n^2+3n^4}{3+2n^2+3n^4} n \frac{P}{t^2}$	Cast Iron $\phi=0.76$			$n=\frac{a}{A}$
	$s=\phi \frac{a^2}{t^2} \frac{p}{1+n^2}$	Cast Iron $\phi=2.26$ Steel $\phi=1.41$			$n=\frac{a}{A}$ ϕ for Steel Estimated.
	$s=\phi \frac{8+4n^2+3n^4}{3+2n^2+3n^4} n \frac{P}{t^2}$	Cast Iron $\phi=0.85$			$n=\frac{a}{A}$
	$s=\phi \frac{B^2b^2}{B^2+b^2} \times \frac{p}{t^2}$	Cast Iron $\phi=0.38$ Steel ϕ 0.24			ϕ for Steel Estimated.
	$s=\phi \frac{B\,b}{B^2+b^2} \times \frac{P}{t^2}$	Cast Iron $\phi=2.63$			
	$s=\phi \frac{B^2b^2}{B^2+b^2} \times \frac{p}{t^2}$	Cast Iron $\phi=0.57$ Steel $\phi=0.36$			ϕ for Steel Estimated.
	$s=\phi \frac{B\,b}{B^2+b^2} \times \frac{P}{t^2}$	Cast Iron $\phi=3.0$			
	$s=\phi \frac{B^2}{t^2} p$	Cast Iron $\phi=0.19$ Steel $\phi=0.12$			ϕ for Steel Estimated
	$s=\phi \frac{P}{t^2}$	Cast Iron $\phi=1.32$			s Independent of B. Deflection only varies.
	$s=\phi \frac{B^2}{t^2} p$	Cast Iron $\phi=0.28$ Steel $\phi=0.18$			ϕ for Steel Estimated.
	$s=\phi \frac{P}{t^2}$	Cast Iron $\phi=1.5$			s Independent of B. Deflection only varies.
	$s=0.228 \frac{A^2}{t^2} p$		$d=0.0284 \frac{A^4}{t^3} \times \frac{p}{E}$		Stayed Plate. The Formula is for One Field
	$s=p\left[\phi \frac{r}{t}+\phi_1 \left(\frac{R-0.5r\left(1+\frac{r}{R}\right)}{t}\right)^2\right]$	Cast Iron $\phi=0.8$, $\phi_1=0.8$ Steel $\phi=0.5$, $\phi_1=0.33-0.38$	According to Stiffness of Cylinder or Riveted Joint		Flat Boiler Head with Round Edges.

American Machinist, N.Y.

NOTE—p indicates intensity of load per square inch expressed in pounds; P indicates total load in pounds.

FORMULAS FOR STRENGTH AND DEFLECTION OF FLAT PLATES

An Investigation of Strength of Crane Hooks

In Professor Rautenstrauch's article at page 615 there occurs a statement which seems to me applicable to a great many other similar cases. "Clearly, neither this formula nor the old formula can be used to determine the breaking load . . . . since the very foundation of its deviation limits its application to the elastic limit of the material." This statement, with the blank properly filled, ought to accompany every theoretical treatment of the strength of materials. The ordinary beam theory is based on a long list of assumptions, most of which are safe inside the elastic limit, but are only wild guesses beyond.

Why does anyone want to know what the breaking load will be on any structure, unless it is something that they want to break? They do not want to know, they only think they do. What they really want to know is what the safe load is. Time was when if we knew what the breaking load was we divided it by some number between 2 and 20 and said that that was the safe load. The range of 2 to 20 was enough to cover considerable judgment, and led many of us to suspect that the only reason for not guessing at the safe load directly was to mystify the nontechnical public by producing a multitude of tests and showing what an amount of exact data we possessed and then guessing at a factor of safety and calling it engineering.

It seems now that we have many materials which can be safely used at a much greater percentage of their breaking load than others. Tests under repeated stress show that the safe load has a pretty decided connection with the elastic limit, and very little with the breaking strength. These considerations seem to confirm the name "Factor of Ignorance" which has been given to the factor of safety. What we need now is a new term which will show the relation of the usable load and the elastic limit. This new factor would still be a matter of judgment but the range would have to be between, say 1 and 2 rather than between 2 and 20.

Some one may say that if we eliminate judgment and do everything by rule there will be no more engineers, that the office boy and a book of rules will be all the engineering force that we need. This is not true. With a smaller range of possible error you may eliminate some freak or accidental mistakes, but you do not eliminate any of the real engineering features of the case. Engineering, I have heard defined as the ability to do something right the first time trying, which would be a pretty drastic definition to enforce literally but it has the right idea. That is, for example, not engineering which simply says "this machine is successful, therefore the machine to do double the size of work must be twice as large in all its dimensions." It would be engineering if the design said "here is a part which travels so fast and at the end of its stroke has such a momentum, which is absorbed by the starting in motion of some other part, therefore, in the new machine I will see that the momentum of the two corresponding parts balances. A boy and a book of rules might accomplish the same result but it would be the kind of a book that would require a boy with brains to read it.

Boston, Mass. CON WISE.

Manufacturers and the Technical Graduates

I was much interested in Frederick W. Taylor's article, page 640, regarding college-trained men. While this prejudice may exist, it is by no means universal, as I know of at least one large concern that makes a practice of taking college men into its shops with a view to making foremen of them if they develop executive ability.

In regard to not taking in a man unless he has been out for at least two years, that is undoubtedly an advantage to the firm that makes the rule, but what would be the result 10 years from now if every manufacturer made the same rule? I would much rather have experienced men to work with, but it seems to me that each shop should try to do its part in developing the next generation.

I am not at all arguing that the school man is the only first-class man, for first-class men come from both the school and the shop, and probably no one is more conscious of his deficiencies than the college-educated man himself after he has been at work a month or two. Other things being equal, it seems to me that in the long run the educated man has the advantage from the very fact that he is trained from the beginning to get more or less of his knowledge from books, and while they are of necessity never fully uptodate, still there is a vast amount of information available that a man would never have time or opportunity to learn by practical experience.

Of course, these books are equally available to the shop man, but a walk through any shop and a few minutes' conversation with the men will show how comparatively few even read a good technical paper, to say nothing of any other literature dealing with the special line of work they are engaged in. It is my experience that far too many shop men are inclined to look with contempt on any knowledge outside of the little they have painfully acquired in the school of experience.

In regard to the statement that the school man has no experience in dealing with workmen; that is true, but I was not aware that anyone expected a young man to go into the shop as a foreman the day after he left school, except in the rare cases where he has a doting father in the works. By the time he is fitted for a foremanship he will probably have rubbed up against shop men enough to know something about how to deal with them.

I believe that given two young men of equal ability, if one were started in the shop and the other went through a good technical school and then to the shop, the school man would, in the majority of cases, be the more desirable man at the end of, say, seven years.

Philadelphia, Penn. W. ALTON.

Wages, Hours and the Cost of Work

The editorial on page 589 calls attention to conditions well known in all shops but does not mention the reverse conditions which are just as well known and probably quite as common.

We once had an order for fifty dies of peculiar design. The price was, I think $40 each. A high-priced man was put on the job and the first die was turned out at a cost of a little over $45 for labor alone. The time slips were shown to the workman and it was pointed out that there was a lot of unnecessary finish; that the working parts were to be finished as accurately as he knew how, but as it was not intended for show, but for work, all the fine frosting with an oilstone pencil could be dispensed with.

The toolmaker's reply was to the effect that if I *thought* I could get anyone to do the work any cheaper and as well as he could I better get him. My very unexpected answer was "come to the office and get your money."

Good men were hard to get at the time and I had decided to do the principal work on the dies myself, when an apprentice in his third year came and asked me if he could try his hand at one of the dies. His wages at that time were about $10 per week. I gave him the job with instructions to go slow and keep his time accurately on the work.

When his first die was finished it was tested and found to turn out work every bit as good as that turned out by the $4 a day man, but it did not look quite as pretty. On making up the time it was found that this die cost about $17. The rest of the dies were then given to the apprentice to finish at $17 each. When the contract was finished, I went over the books and found that the apprentice had averaged over $25 per week on the die job. Of course, some time was saved by leaving off unnecessary finish but it is so difficult to get the fine toolmaker and especially one, who like my man, had worked in a watch-case factory, to believe that there is such a thing as *unnecessary* finish. I believe if he had been given the job to get out a set of grate bars for a furnace he would have surface ground and lapped them.

Very few, if any, men get what they are worth. Very often the man with the low wages is worth more than the man alongside him who is getting high wages. The man with the high wages very often gets them because he is able to throw a successful bluff. I know of more than one man who is paid twice what he is worth. The peculiar thing about one of them is that if you ask him a question about the work which he is supposed to be well posted in he will never admit that he does not know but will throw a bluff no matter how foolish his answers are. I believe he has been throwing this bluff so long that he has *himself* fooled into thinking he is an expert.

New York. E. A. DIXIE.

Replying to Advertisements

I read an article in the AMERICAN MACHINIST regarding the above subject and am glad this has come up. I have answered several advertisements in the AMERICAN MACHINIST and have heard from only two. With regard to inclosing a postage stamp, I was advised by a business friend never to do so. I myself have had charge of two different shops, and received a great many applications by mail. Those without stamps received my attention just as readily as those with. I would like to know if my friend is right or wrong about inclosing stamps.

Vandergrift, Penn. J. A. ANDERSON.

In a recent number of the AMERICAN MACHINIST there was an editorial calling attention to the habit some advertisers have of not replying to letters from those seeking employment. From personal experience I could give a number of firms that do this, even when a stamped addressed envelop was sent for reply; and in some cases it has been even worse than that.

Recently I had a letter from a large Southern firm. They were so urgent that they wanted to know how soon I could report if they wired me. Owing to a number of details I could not wire them, so sent a *special delivery* letter explaining that an early reply was wanted for I had another offer that must be accepted or rejected by a certain date. I then waited several days, losing time, and running chances of losing my place with the other people, and did not receive as much as a postal card in reply.

Then there has been one case at least where the manufacturer has obtained help through misleading letters, in which he represented that through the cheapness of living, their offer was worth from 5 to 10 cents an hour more than it would be where the employee was working.

There doesn't seem to be any fixed rule to go by, for sometimes some of the largest manufacturers show the least concern, and again some of the small shops will be the most courteous.

Doubtless both manufacturers and employees are sometimes "taken in," but I have secured some good positions through the AMERICAN MACHINIST and I don't believe I ever stung anyone. To be sure, there have been times when one or both parties have been disappointed, but it was from lack of a complete understanding of conditions, and I believe very few workmen who have good, sound sense and a reasonable amount of practical experience in different shops will put up a bluff, for although they make it go for a short time, they will fall down sooner or later.

If employers would state the exact conditions of shop, work and living, the prospective employee would be able to judge whether or not he could handle the work to advantage.

Indianapolis, Ind. H. M.

Noise and Friction

We refer to your editorial "Noise and Friction," page 674.

Perhaps this editorial appeals very strongly to me, because I am not a mechanic, and because, in spite of the fact that I have brought up this very question with practical men, I have found very few in sympathy with me. This may be because they were not much interested in our line.

While we have felt that we were absolutely in the right, one very bright mechanical man even told me that I was crazy, because I claimed a heavier cut on a particular make of shaper, where the power to the driving shaft was acknowledged the same. We realize that the shaper does not seem to hold the interest of the general run of mechanics that is manifested in other machine tools, yet the mere fact that it is not strictly mechanical in design, in our opinion calls for more care in its construction.

Our argument is about as follows; to get a point to start from, we are willing to admit that the belt contact is the same on all back-geared crank shapers; in fact we are willing to concede any advantage here that others may wish to claim, except that the relation of our countershaft speeds to the gear ratio is such that we obtain correct tool travel under all conditions. The driving power being the same, if one shaper will take a heavier cut than another, is it not evident that there is greater loss in the working parts of the weaker machine, which means more friction, and as we have always claimed, more wear and tear somewhere?

Another way to arrive at the same conclusion, in our opinion, is to take a motor-driven machine with a recording watt meter attached; take a given cut at a given speed, with conditions as near similar as possible, and the shaper that requires the greater power to remove the same quantity of metal is certainly the least efficient. In shapers, as the overhang is considerable, the parts must be heavy enough to withstand the twisting strains without buckling, and while a heavy well-built machine might require as much power when running idle as a very light one, there ought to be a great difference in favor of the heavier shaper when taking a heavy cut; if not, the weight is a detriment.

We wonder that there could be a difference of opinion as to the truth of your editorial, but we find practical mechanics much like doctors, no two of them being of just the same opinion. Well, perhaps they will all agree that the main line in their shop should be straight; then why not all the little shafts, etc., in the various machines, as a multitude of small defects will surely equal a great one? There seems to be a feeling that heavy duty and accuracy do not go together, but it looks as if a heavy-duty machine tool must be rigid and well made to do heavy duty, and we believe these are the qualities that insure accuracy.

We hope the day will come when machine tools will have an efficiency rating; we hope the day will come when the efficiency rating is given greater consideration than price; we hope the day will come, and come soon, when real worth will be known and appreciated; when a piano finish on the outside will not be considered more to be desired than the light-running qualities of, the machine under stress. Veneering may be all right in the parlor, but it has no place in the average machine shop. Why is it that practical machinists insist on a tool being plastered up so that defects can be easily hidden, and that a bearing must be dug full of holes, as is done in hand spotting, when it either hurts a good bearing or covers up the defects of a poor one? We do not see why a machine-shop proprietor should object to a flaw in a tool, provided it does not hurt the efficiency of the machine in producing work. We believe in proper cleanliness to avoid fire loss and for the sake of health, but in the average shop, where production is paramount, after a few months' use there is very little of the polish in evidence, and the real test is, is it as silent running and accurate as when first set up? If a machine tool has generous bearings, surrounded by sufficient metal, and the machine work is accurate, so the assemblers do not have to file and scrape excessively, durability must be the result.

Cincinnati, O. A. M. WATCHER.

In a bulletin issued by the United States Geological Survey dealing with the utilization of fuel in locomotive practice it is stated that locomotives in service on the railroads of this country consume more than one-fifth of the total coal production of the United States.

AMERICAN MACHINIST

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November 4	39,750
November 11	19,000
November 18	19,000
November 25	19,000

This paper reaches 39,750 *separate readers each month and* 19,000 *each week.*

None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

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Shop Equipment under Conditions of Business Activity

During the past two years we have counseled the overhauling of shop equipment, "cleaning house" in a shop sense, and anticipating the time when the shop would hustle once more and strain its plant to the limit to meet the demands of consumption. In some quarters that condition is here, and shops are running to the limit of time and equipment.

As before, it was necessary to brace up for what was coming; now it is necessary to be watchful to keep things going. Particularly does this responsibility rest upon the men having care of the physical plant, the motive power, heating, lighting, floor space, storage room and machine tools.

As new machines are set up here and there the power load increases; this increase may be very gradual, but in time a condition of overload is reached. It is easy to add an incandescent light to an old circuit when a new tool is belted up, or to put up an arc when new storage space is made available. But after this process has gone so far the main and taps are overloaded with a consequent reduction of voltage, a loss of light over the entire system, or other complications.

Many shop floors are not designed for heavy machine-shop loads. When work begins to pile up around the machines, a large number of balance wheels, or a quantity of gears, or any parts that are heavy and compact may overload a section of floor much beyond its carrying capacity.

Under normal conditions a shop may take the best of care of its machine tools, but when one is working 22 hours a day, with every lost hour putting production behind, it is very easy to slur over repairs, putting them off until a more convenient season. Such a course may be defensible, for the production may be of such importance that the life of the machine can be taken as a very short space of time, and yet be a good business proposition.

Again, it is very easy to have a condition of production develop where the machine-tool equipment is unbalanced. Such a change in production may take place so gradually as to be unperceived, yet the consequence may be almost disastrous. Thus it is of vital importance to watch the various kinds of machine tools, study the trend of production and anticipate future needs by orders far enough in advance to protect properly. Of still greater importance is this last point, as deliveries are promised more and more in advance of the date of the order.

Therefore, watch the physical plant when the shop is hustling and changes are being made because of new requirements.

Published Records of Machine Tool Performance

A short time ago a shop superintendent, speaking of records of machine-tool performance, remarked: "The publishing of the time taken to do a particular job on a certain milling machine or screw machine or some other tool is undoubtedly all right, but sometimes it makes me a heap of trouble. My board of directors is composed of business men who know nothing about the machine shop except the dollars and cents end. The general manager is no wiser. Yet those men will hunt through advertisements, etc., for records of jobs done on machines such as we have in our equipment, and then compare the time with the time on some similar job of ours.

"For various reasons my time is usually longer than the published time, so they call me to the office and want to know why I can't do such-and-such a job as quickly as the other fellow does.

"Well, the other fellow uses softer or cleaner stock than I do, or his special tools are particularly designed for the job, or his operators are experts, or, etc. I tell them all this and then go off and try to equal or better what the other fellow has done."

The fact that the time for doing a certain job is longer in an average shop than the time published as a record on a certain machine is no discredit to the shop superintendent. If the record of production was not excellent, as to time, quantity of metal removed or accuracy, there would be no motive for talking about it or publishing it. The fact that a certain firm is glad to spread out such a statement shows that it is out of the ordinary of machine-shop work.

The superintendent's contention that such records are made on machine tools turned-up for the work, fitted with the best of special tools and holding devices designed by men who are experts in such design, and operated by expert operators is undoubtedly largely true. But the fact remains that such-and-such a record has been set up. It is possible to do work at such a high rate. Then, why not do it?

The last sentence of the superintendent's remarks covers the situation fully and in the right spirit. "I tell them all this and then go off and try to equal or better what the other fellow has done."

Records are transitory. They are only made to be broken by the other fellow, if he can. The record for the biggest and fastest battleship is being kicked around among the various nations, and just now is with us because of the "North Dakota." Just so, machine-shop records of production are set up only to be bettered.

It is for the good of the industry that all of its units should work at the highest rate of efficiency that is obtainable.

Every machine tool should be run as effectively as possible, not only for the benefit of the shop it is in but because it aids broadly our industrial position among the nations of the world. To that end efforts should be put forth to raise the general productiveness of machine tools to the highest level possible. Or, standardize such production, if you will, at the highest point that can be generally reached.

One of the most potent forces that we know of tending in this direction is the systematic publishing of valuable records of machine-tool performance.

Beginning of a Great School of Engineering

Last June Harvard University received $1,000,000 under the McKay bequest for the development of its Graduate School of Applied Science. Hereafter this endowment will grow at the rate of approximately $200,000 per year, until at the expiration of the last annuity the principal, $5,000,000, will be paid over. In all probability the total endowment will reach from $12,000,000 to $15,000,000.

What a magnificent sum for furthering engineering education!

In preparing for the new work in applied science the university three years ago began to refuse admission to that department; thus the old group of undergraduate students studying for professional degrees has now practically disappeared. Hereafter, although continuous work with greater or less specialization from the beginning of college will be maintained, professional degrees will be granted only in the Graduate School of Applied Science.

The purpose of the instruction in the division of engineering, in civil, mechanical and electrical engineering, is thus set forth in the *Official Register of Harvard University:* "This instruction includes work of an introductory nature primarily for students of Harvard College, as well as professional instruction for students in the Graduate School of Applied Science. The main object of this instruction is to train men for the profession of engineering, but much of it is a valuable preparation for those who are looking toward executive positions in industrial enterprises of any kind." Without in any way attempting to analyze the course of instruction, or the facilities, the outlook for a great school of engineering is bright indeed.

The question of shop work is vital in any engineering course, and as indicated in the register before us the provisions for it seem inadequate. Four courses are listed: Chipping, filing and fitting; blacksmithing; patternmaking and foundry practice; machine-shop practice. These courses total 360 hours of summer work at the Cambridge Manual Training School.

Compare this amount of shop work with that in the course in mechanical engineering of the Worcester Polytechnic Institute, where 1436 hours are devoted to the shop during the four years. Or again compare it with the half-time plan of the University of Cincinnati.

When we consider this magnificent bequest and the possibilities that it presents for developing a school of engineering, we cannot but regret that alumni sentiment prevented the Massachusetts Institute of Technology from merging with Harvard in creating one great engineering institution in Greater Boston. Many of the advantages urged for business consolidations would seem to apply with force to such a combining, which, unfortunately we believe, did not take place.

New Publications

THE PREVENTION OF INDUSTRIAL ACCIDENTS. By Frank E. Law, M. E. and William Newell, A. B. and M. E. Published by the Fidelity and Casualty Company, New York. Price, 25 cents.

This is a paper covered book of 190 pages and contains 72 illustrations, dedicated to the policy holders of this company in the hope that it will be found useful to them. It contains a large amount of useful information in regard to the prevention of accidents in various kinds of manufacturing and includes boilers, engines, elevators, together with wood- and metal-working machinery. This is one of the many indications of an increasing interest in the prevention of accidents in all kinds of industry, and we believe that not only every manufacturer but his foremen should read this book for the information and suggestions that it contains. This is to be followed by other pamphlets devoted to specific industries, and we feel that the publishers should be commended for the work they are doing along that line.

THE SLIDE RULE. By J. J. Clark. 62 4¼x6¾-inch pages; 6 illustrations. Technical Supply Company, Scranton, Penn.

In his preface the author, referring to books already published on the slide rule, says: ". . . . The instructions studied were not understood, and that they were so difficult, meager, or ambiguous that the reader did not have the patience to study them until he had mastered the intricacies of the rule." This is far too sweeping a condemnation of existing books dealing with the slide rule; for there are several excellent books of this character that are well known to engineers and students. While this book covers the ordinary uses of the slide rule, its treatment in some ways is not in keeping with other works. No illustrative settings of rules are shown; yet these are one of the most valuable means that can be used to explain the subject. The book is not indexed, neither has it a table of contents.

Personals*

Ernest W. Nicklin, mechanical engineer, with the Smith Engineering Company, Detroit, Mich., has recently assumed a similar position with the Detroit Brass Works of that city.

E. W. Burgess, until recently a mechanical engineer with the Whitlock Coil Pipe Company, Hartford, Conn., is now employed in the engineering department of the Metzger Motor Car Company, Detroit, Mich.

Earle J. Banta, who has been connected with the Isthmian Canal Commission in the capacity of mechanical engineer, at Culebra, has become chief engineer of the Cincinnati Equipment Company, Cincinnati, O.

Walter I. Bitterlich, employed as a machine designer with the Bresnahan Shoe Machinery Company, Lynn, Mass., has accepted a position with the Hood Rubber Company, Watertown, Mass., to act in the capacity of chief draftsman.

Claude E. Cox has recently become connected with the H. E. Wilcox Motor Car Company, Minneapolis, Minn., and will act as engineer and assistant manager. Mr. Cox was formerly employed by the Interstate Automobile Company, Muncie, Ind., in a similar capacity.

John McInnes, general superintendent of the Bath Iron Works, Limited, Bath, Me., is now in Scotland, his former home, on a combined business and pleasure trip. Mr. McInnes will visit the ship-building establishments on the Clyde in the interest of his firm, and is expected to return the latter part of December.

We have great satisfaction in announcing an addition to our editorial force in the person of C. H. Logue, whose name is well known to our readers as a contributor. Mr. Logue has for 10 years been associated with the R. D. Nuttall Company, of Pittsburg, rising successively through various positions from that of draftsman to mechanical superintendent.

A. S. M. E. Monthly Meeting

The regular monthly of the American Society of Mechanical Engineers was held in the Engineering Societies building, New York City, on the evening of November 9.

Two papers were read. "Reinforced Concrete Beams" was the subject of the first, which was presented by Prof. Gaetano Lanza and L. S. Smith, of the Massachusetts Institute of Technology, and the second paper was by Prof. Walter Rautenstrauch, of Columbia University, on "The Design of Curved Machine Members Under Eccentric Load." The tests on the strength of crane hooks, which were recently described in these columns, formed a part of the author's investigations.

*Items for this column are solicited.

New Tools and Machine Shop Appliances

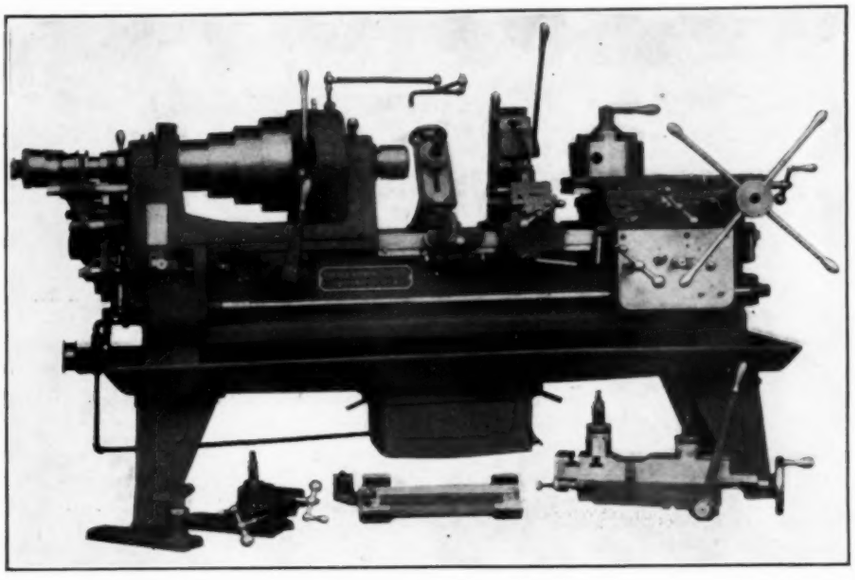
Showing New Ideas in Machine Shop Equipment That Make it Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

20-inch Universal Monitor Lathe

This machine is designed for general brass and similar work of heavy character and is designed to manufacture without special tools in a more economical way than is possible with an ordinary universal monitor lathe.

The turret carriage is provided with an automatic all-geared feed similar to that of an engine lathe with quick-change gear box. The coarsest feeds are 8, 11½, 14 and 18 per inch, conforming with the standard pipe threads. By means of a slip gear, these four feeds are multiplied by 4 and so can be used as turning and boring feeds, making eight instantaneous changes. Other feeds and pitches can be easily obtained by change gears.



TWENTY-INCH FULL UNIVERSAL LATHE

Interposed between the upper and lower part of the turret carriage is a double dovetailed plate, to the lower side of which is a shoe swivel connected which slides on the bar of the taper attachment shown below the oil reservoir of the bed. The frame of this attachment slides on the inside of the bed and a clamping bolt holds it in position. The whole arrangement can be readily removed when not in use and no special provisions are necessary in the construction of the bed. By this arrangement, in and outside, taper and straight threads can be chased by the turret without the use of a tap or die.

The upper part of the intermediate dovetailed plate has a screw with ball crank for cross feeding by hand and positive clamping stops are provided for setting the holes in the turret in alinement with the spindle. The turret-carrying slide is provided with a pilot wheel for rapid movement and also with a screw for finer adjustment.

The pilot wheel with stem is removable so as to be out of the way when the screw feed is used.

The turret revolves on a stem with adjustment for wear and the locking bolt withdraws at the return movement of the top slide, making it semi-automatic.

The headstock has all-inclosed friction back gears, the friction is of the toggle-joint type and so designed that the whole operating mechanism can be put in place or removed without taking out the spindle. The spindle is provided with an automatic chuck operated by the handle shown below the cone pulley. The chasing bar has a yielding follower holder maintaining contact with the leader when chasing taper work. The taper attachment has nurled screws for minute adjustment.

The machine is also equipped with a vertical forming rest, cutting-off rest, hand and slide rest so that it is adapted for all work in manufacturing brass or similar goods. It is also provided with a pan, oil reservoir, pump and piping which adapts it for iron and steel work. It swings 20½ inches over the V's, has a 6-foot 6-inch bed and weighs 3600 pounds.

The machine is made by the Dreses Machine Tool Company, Cincinnati, Ohio.

Nine Spindle Milling Machine

The machine shown in Fig. 1 is a nine-spindle milling machine, and is an excellent example of specialized milling-ma-

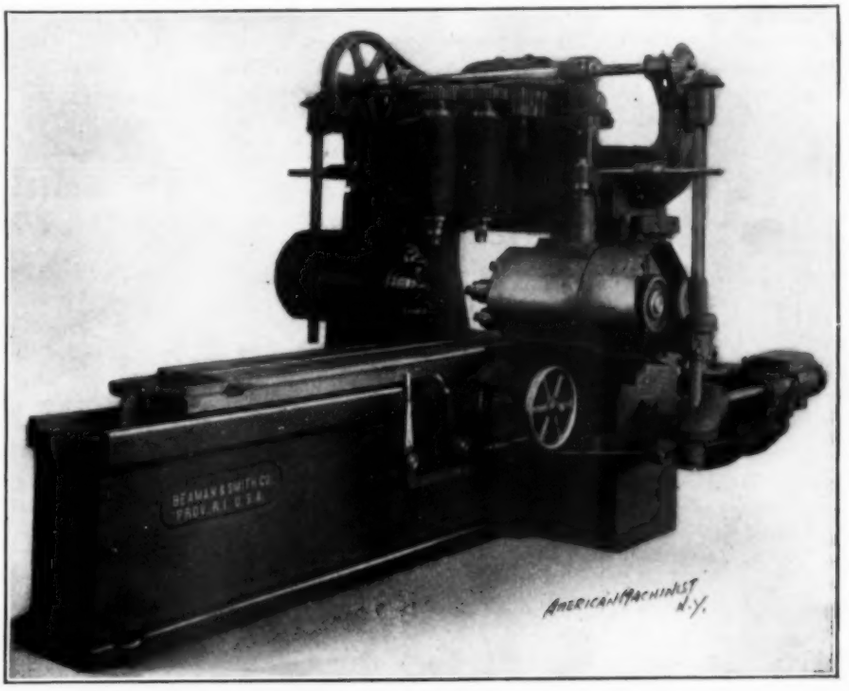


FIG. 1. NINE-SPINDLE MILLING MACHINE

chine operation, its special purpose being for automobile cylinder work.

A good general idea of the machine is given by the photograph, while in Fig. 2 is shown a section of spindle boxes, quill, etc., for one of the spindles. All spindles

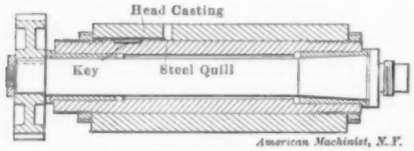


FIG. 2. REAR VERTICAL SPINDLE IN SECTION AS APPLIED TO NINE-SPINDLE MILLING MACHINE

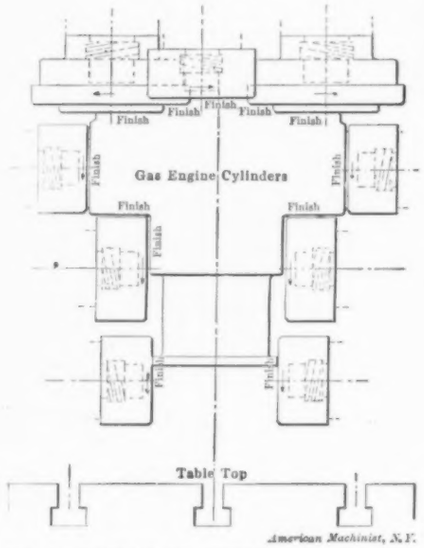


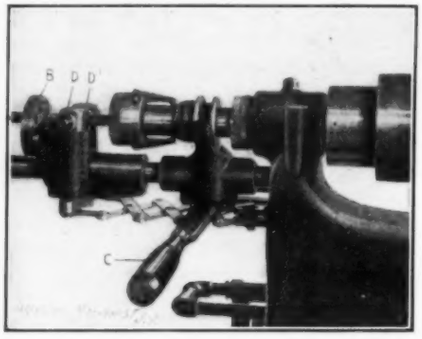
FIG. 3. DIAGRAM OF CUTTERS USED ON NINE-SPINDLE MILLING MACHINE

have the same design, although differing in size. In Fig. 3 are shown the outline of table top, location of gas-engine cylinder and the nine cutters in position for finishing the several surfaces. The machine is the product of the Beaman & Smith Company, Providence, R. I.

A New Screw Machine Wire Feed

The wire feed illustrated in the accompany halftone is now being used on the screw machines manufactured by the F. E. Wells & Son Company, Greenfield, Mass.

This form of feed was devised for the purpose of accomplishing in the movement of one lever the operations of opening the chuck, moving the stock forward, and closing the chuck again in rapid manner. When the two fingers marked *D D* are adjusted to the certain size of stock, they will feed the bar the whole length, so that the necessity of fastening a dog or other device to the stock is obviated. The principle on which this wire feed works is that the two fingers work with a cam motion so that when lever *C* is pulled forward the two fingers swing in such a way as to bring them closer together, thus binding them on the stock, and pulling it forward the required distance. After the stock has been pulled forward a movement of lever *C* opens the fingers ready for a new hold, at the same time tightening



WIRE FEED USED ON SCREW MACHINE

the chuck in the spindle for holding the work. Another novel feature of this construction is shown at disk *B*, which forms a guide for the stock. The "lazy tongs" construction shown is simply to give a longer range or feed to the stock.

The Boswell File

At first appearance this looks very much like the rasp with which we are all familiar, but a closer examination shows that the teeth are backed up by more metal and present a much more substantial form of cutting tool than in the old rasp. It will also be noted that the teeth are formed in regular rows which are curved so that it resembles the milling file with the addition of a series of angular cuts across the curved teeth, as can be seen.

This file is claimed to work equally well on all kinds of material from steel to bone or celluloid, without clogging, and that it

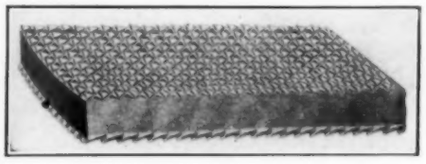


FIG. 1. TEETH OF THE BOSWELL FILE

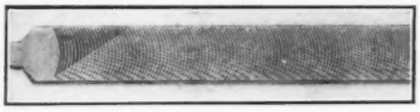


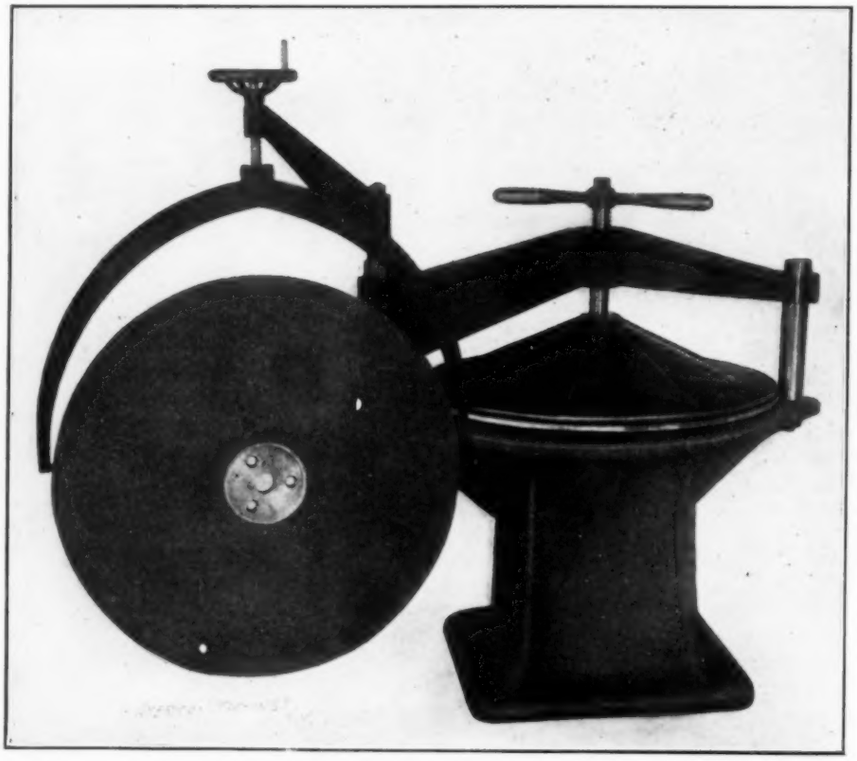
FIG. 2. THE FILE ITSELF

has no tendency to slide or work sidewise, when only a portion of its surface is being used. It is manufactured by Thomas Boswell & Co., Sheffield, England.

A Large Wheel Press

The wheel press illustrated in the accompanying halftone is a recent product of the Gardner Machine Company, Beloit, Wis.

This company is now manufacturing its disk grinder in a larger size than heretofore, accommodating disk wheels 30 inches in diameter or under, and the wheel



A LARGE WHEEL PRESS

press here shown is an outgrowth of this advance in disk-grinder construction.

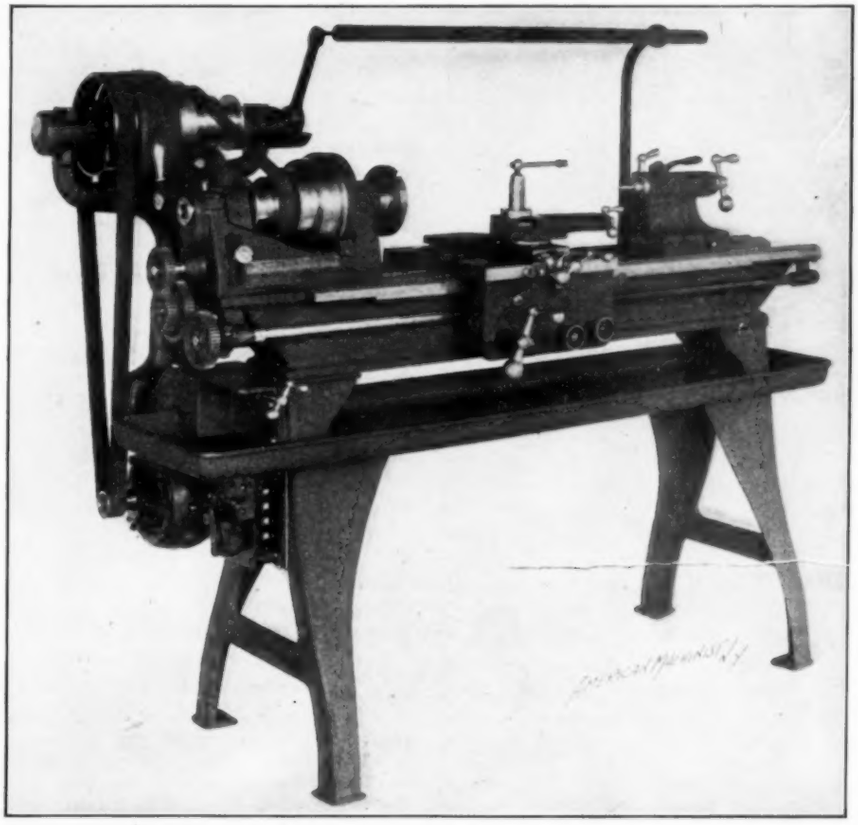
The 30-inch steel disk wheels weigh about 175 pounds, and as can be noted from the photograph, the press is equipped with a lifting attachment for convenience in handling.

Motor Drive for Star Lathe

A new type of motor drive has been brought out by the Seneca Falls Manufacturing Company, Seneca Falls, N. Y., for their 9- and 11-inch "Star" lathes, as shown in the accompanying illustration.

The advantage of this drive is its adaptability to the varying conditions in the use of all kinds of motors. The drive has been designed to use any kind of constant- or variable-speed motor, non-reversible, preferably with a speed of 1000 to 2000 revolutions per minute. The motor may be easily attached and a pulley of proper size on the motor transmits power by belt to the countershaft pulley running constantly in one direction; a belt is also used from the cone on the countershaft to the cone on the head spindle. Means are provided for quickly tightening belts.

Starting, stopping and reverse rotation of the lathe spindle is controlled by shifting the bar placed horizontally above the lathe within easy reach of the operator. Moving the shift bar to the left imparts forward motion to the lathe spindle, and to the right reverses; bringing the shift bar to the center position stops the lathe. The driving mechanism consists of friction clutches and gears for reversing the motion, incased and running in an oil bath. The construction is simple and thus disarrangement or damage is unlikely. The bearings are lubricated by oil rings.



MOTOR DRIVE FOR STAR LATHE

A Holder for Blueprint Paper

The keeping of blueprint paper in good condition, especially in small drawing rooms, is very often an annoying problem. The device shown is to take the place of the plain tube which necessitates taking the whole roll out every time a piece is to be cut off, and seems to possess many good qualities.

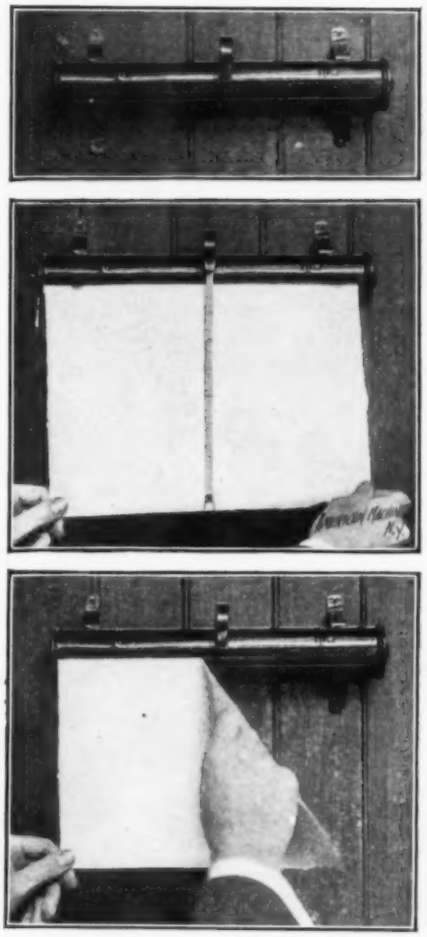


FIG. 2. CLOSED AGAINST THE LIGHT
FIG. 3. MEASURING THE PAPER
FIG. 4. TEARING IT OFF

As shown in Fig. 1 it consists of an outer case to be fastened out of the way either on a wall or table as shown in Fig. 2. The protecting case shown at the left slips inside of this and carries the paper on a roll as indicated beneath. The wooden center fits the roll and runs on the stud projecting from the inside of the cap.

Fig. 2 shows this closed with the roll of paper thoroughly protected both against

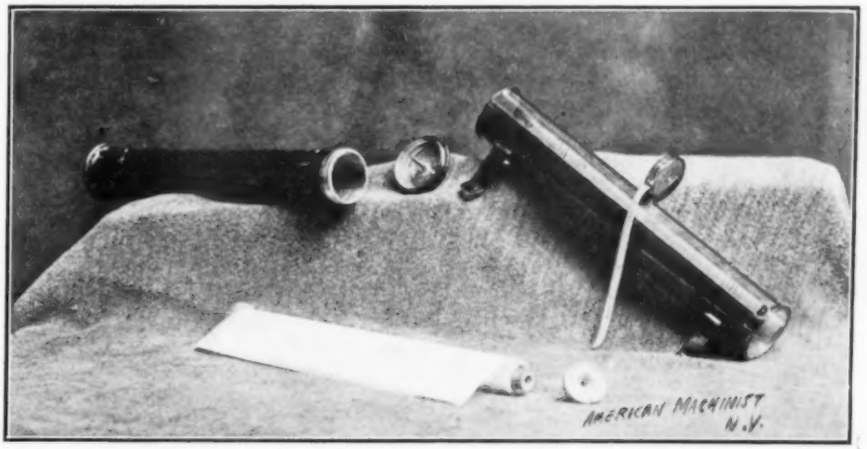
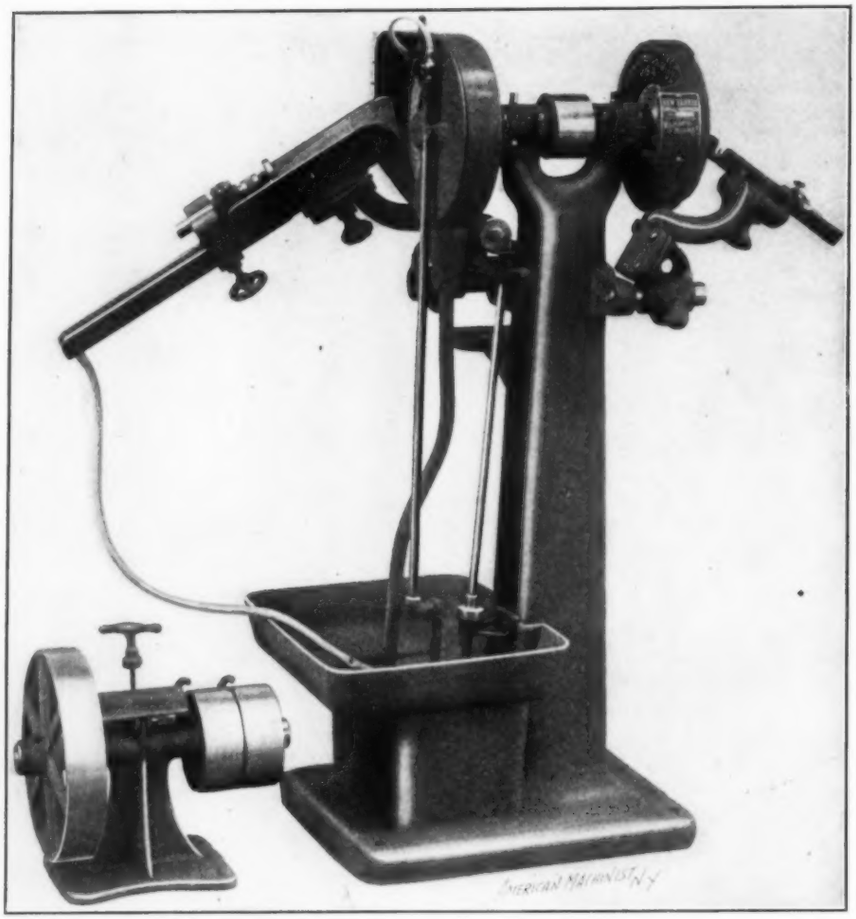


FIG. 1. HOW IT IS MADE



"YANKEE" DRILL GRINDER

light and dirt. When it is desired to use some paper, the roll is turned slightly by the end, which brings out the edge of the paper so it can be easily grasped. In the meantime the tape measure has been drawn out to the distance required and the paper is simply pulled down to the end of the tape, and then torn off as indicated in Fig. 4. This prevents wasting paper, saves it from being light struck, and seems to be just the thing for the average drawing room. It is made by George Chalmers Brown, New London, Conn.

Drill Grinder

In this machine is combined the capacity necessary for the handling of large drills, including the desirable wet grinding feature, with convenient means of handling small drills. The halftone will make the arrangement clear. The large holder for wet grinding of large drills has a normal capacity of 2¼ inches maximum down to ⅛ inch drills. On account of the convenient arrangement, however, it is expected that drills of ½ inch and under will be ground in the small holder which has a capacity from 5/8 down to No. 60 drills. A fine-grade emery wheel is provided for the small drills and it will be noticed that two operators can work at the different holders without interfering with each other. Both holders embody the well known "New Yankee" construction in which the peculiar angle of the V-shaped trough automatically locates each size of drill in the right position for grinding. As is usual with this make of drill grinders the clearance can be adjusted when it is necessary, providing for, first, the small amount of clearance desirable for working in hard steel, and then the much greater clearance necessary for soft metal. The normal clearance, however, is continuously maintained for drills of various sizes without the necessity of adjustment on the part of the operator. The maker is Wilmarth & Morman Company, Grand Rapids, Mich.

An Elliptical Chuck That Is Balanced

This is a departure in an elliptical chuck and is equally useful either in spinning or for elliptical die work. One great advantage in the former work is that it is well balanced even at high speed. Figs. 1 and 2 show it equipped for most kinds of work, while Fig. 3 gives us an idea of its operation.

The bracket *A* is screwed to the front of the head and supports a sleeve which surrounds the spindle nose *B* and carries two gears, which are shown directly behind the center of the chuck. The outer gear is part of this sleeve and is held stationary by being clamped in the bracket. The other gear is free to move around the sleeve as a bearing when moved by the gear *D*, which is in turn driven by the crank handle, shown in front of the headstock. This in turn moves the two gears *E E*, and these turn the screws *G G* through the bevel gears *F F*. In this way the two small cross slides which control the movement of the outer portion of the chuck carrying the work, are moved in unison and give any free determined difference between the two diameters of the ellipse within the capacity of the chuck. A scale operated by the crank handle and indicated in Fig. 1 shows exactly what will be produced at any given setting, its limits being 3 inches in this case.

The operation is as follows: When the lathe spindle turns the cross-arm *H*, which is attached to it, also turns. The driving gears *E E* rotate with the cross-arm,

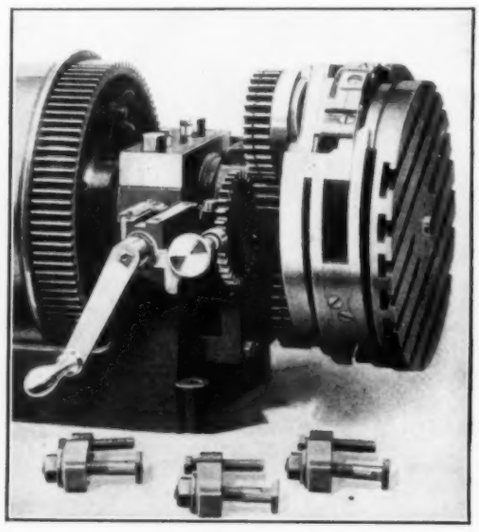


FIG. 1. ELLIPTICAL CHUCK FOR DIE WORK

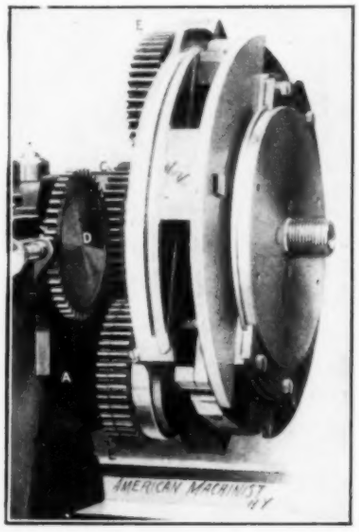
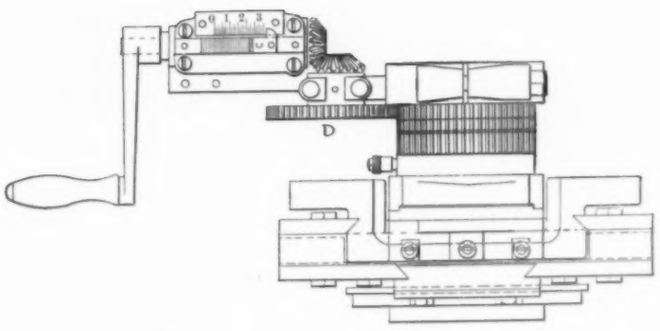
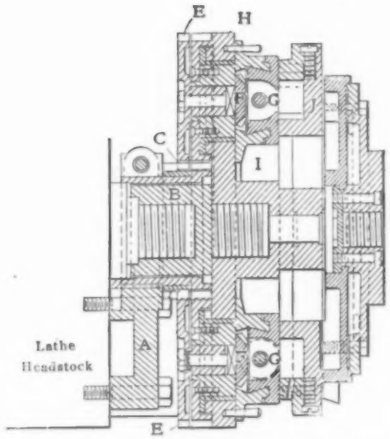


FIG. 2. ARRANGED FOR SPINNING





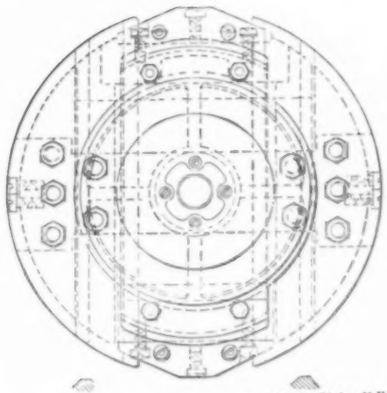


FIG. 3. DETAILS OF ELLIPTICAL CHUCK

and as they mesh with the stationary gear they turn the cranks *I*, and if these are moved away from their central position, they drive the slide back and forth in the plate *J*. With the crank pin set at zero and the tool at the lathe center, the chuck will turn a perfect circle, but by moving the crank pins off the center, which can be accomplished either with the chuck stationary or running, any desired proportion of an ellipse whose difference in diameters is not more than 3 inches can be obtained.

The balance is secured by setting the cranks so that the front and rear slides are both driven toward the center or away from it at the same time, so as to balance the opposing forces. This is being built by P. Pryibil, 512 West Forty-third street, New York City.

Radial Drill and Tapping Machine

The novel features of the radial drill and tapping machine illustrated herewith are embodied in the head in which the spindle is driven by friction clutches, making it possible to drive large pipe taps, and back them out by reversing the spindle while under strain. As the back gears are placed between these friction clutches and the spindle, it is only necessary for them to pull about one-fifth of the power required at the spindle.

The drawing shows the gears and method of driving. The power is transmitted from the column to the head through shaft *A*. Bevel pinion *B* meshes with bevel gears *C* and *D* which run loosely on the shaft, and are fitted with friction rings. *E* is the sliding member of the friction clutch which connects either bevel gear *C* or *D* through their rings with shaft *F*, causing the spindle to run, respectively, forward or backward. Spur gear *G* is a part of shaft *F* and meshes with gear *H*, which runs loosely on sleeve *L*. Spur gear *I* is keyed to shaft *F* and meshes with gear *J*, which is also loose on sleeve *L*. Gears *J* and *H* have jaw clutches on their hubs to engage with sliding clutch *K*, which is keyed to sleeve *L*. *L* is a steel sleeve interposed between the spindle and positive clutch *K* and keyed to each so that no strain comes upon the spindle, and there is no tendency to disengage the clutches when the spindle travels up or down under strain. Clutch *K* is used only when changing from the high to the low speed which, with the cone-pulley drive gives eight speeds at the spindle or 12 speeds with the speed box. The friction clutch *E* operated by the long lever *N* at the right of the head is used to start, stop or reverse the spindle, and operates without shock or jar. *M* shows where shafts and spindle are journaled in the head. *O* is the back-gear lever that operates clutch *K*.

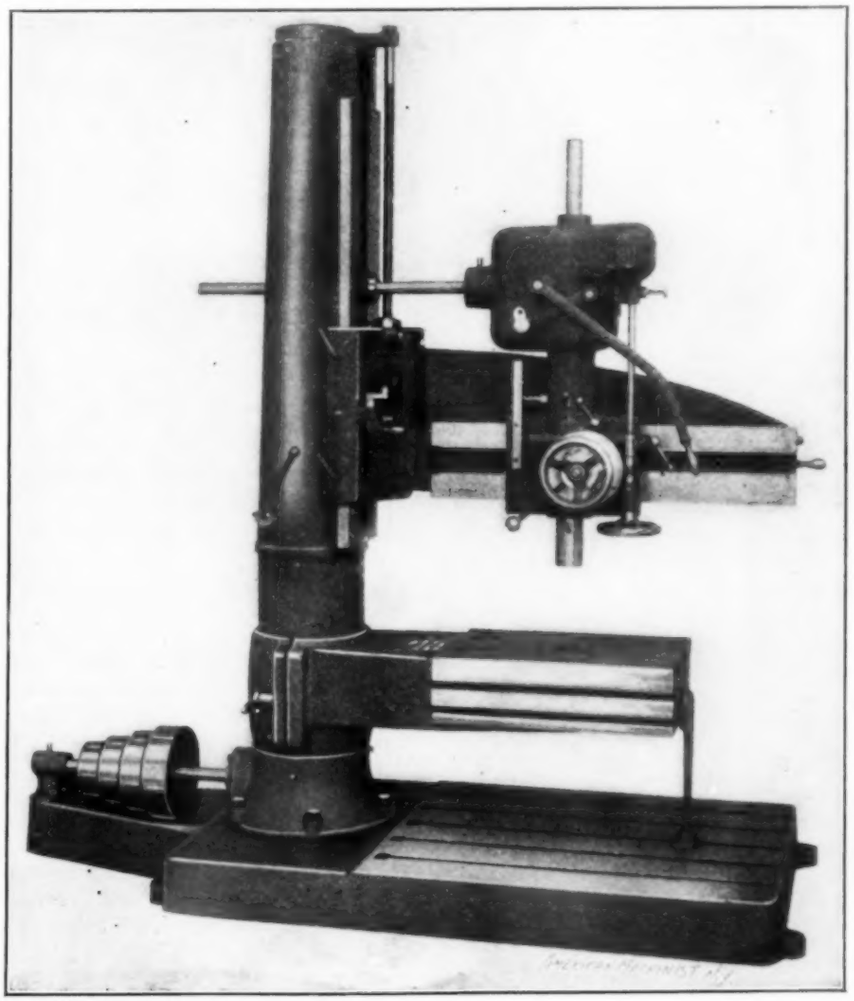


FIG. 1. RADIAL DRILL AND TAPPING MACHINE

The depth gage *R* and automatic stop for the spindle are departures from the ordinary variety in that the graduated scale, instead of being on the spindle and moving with it, is attached stationary on the head. The tripping dog and pointer *S* is adjustable vertically, and clamped in position by a bolt working in a T-slot in the spindle sleeve. With this arrangement, the zero point being at the lower end of the graduated scale and in a fixed position, all that the operator has to do in preparing to drill or counterbore a hole to a given depth is to bring the drill or counterbore down on the surface of the work, loosen the binder on the tripping dog, set the pointer opposite the correct graduation on the scale, tighten the binder and start the feed. When the pointer gets to zero the feed will be knocked out automatically,

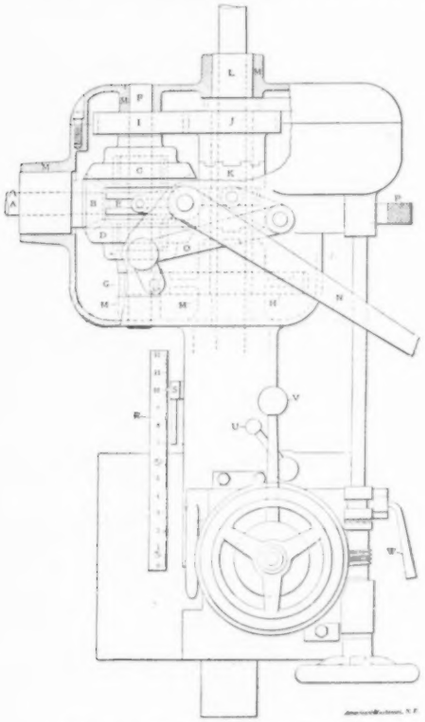


FIG. 2. DETAILS OF CONSTRUCTION

and the spindle can travel no farther. All depths are read from zero.

Four rates of feed are provided: 0.008, 0.011, 0.014, 0.017 inch per revolution of the spindle, secured by turning the nurled knob *P*. The power feed is taken from the upper part of the spindle through a train of spur gears to the shaft shown at the right of the head, all held in the upper part of the head the same as the driving gears, then through the worm and worm gear to the spindle. The worm gear drives the spindle-rack pinion through a friction clutch operated by the quick return lever *V*. The lever *W* operates a saw-tooth clutch which can be disengaged when it is desired to use the hand feed.

The head is gibbed, and is adjusted on the radial arm by rack and pinion, actuated by a handwheel, and can be securely locked in position by a binder screw and lever *U*. A speed box can be applied to this machine and a variety of tables can be furnished. All gearing is inclosed. This machine is the latest type built by the William E. Gang Company, Cincinnati, Ohio.

Making Thread Cutting Tools

By A. R. White

Perhaps there is no subject which arouses as much interest, in, and creates as much discussion, by, toolmakers, as the production of threaded parts within commercial limits of error.

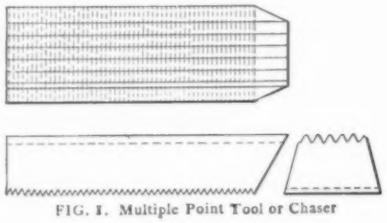


FIG. 1. Multiple Point Tool or Chaser

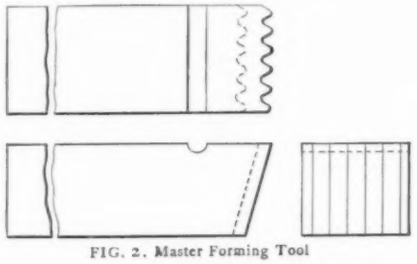
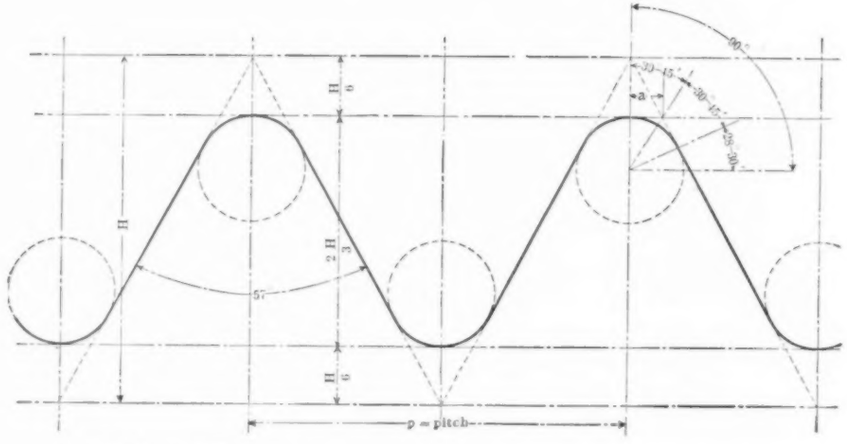


FIG. 2. Master Forming Tool



$H = \frac{\cot 28°30'}{2} = \frac{1.84177}{2} = .920885$

$\frac{H}{6} = \frac{.920885}{6} = .1534808$

$a = \frac{H}{6} \times \tan 28°30' = .1534808 \times .54296 = .0833339$

$r = \text{radius} = a \times \cot 30°45' = .0833339 \times 1.68085 = .14007$

$H_1 = H - \left(\frac{H}{6} \times 2\right) = .613925$

American Machinist, N.Y.

FIG. 3. DIAGRAM OF WHITWORTH THREAD—MASTER TOOL CALCULATIONS

This subject has been contributed to and ably handled by many writers in the technical press, but perhaps an explanation as to how an efficient thread-cutting tool was designed and operated may be of interest to readers.

Fig. 1 shows the multiple-point tool or chaser, having a serrated back and being held by the beveled side, while on the front face are formed the teeth which do the cutting. These teeth are formed by the use of the master forming tool shown in Fig. 2, which is made with the greatest care and thoroughly tested before being used. It is used in much the same manner as the master tools are used in making forming tools for the production of circular screw-machine tools, that is, by the placing of the work, after roughing out to approximate shape, in a special milling-machine vise, and passing the milling-machine table under the master tool which is mounted in an arbor in the milling-machine spindle, the spindle being stationary and the work fed to the tool by the use of the micrometer collar on the elevating screw spindle.

In use the chaser is presented to the work with the front face inclined at an angle, for clearance, and in the case under consideration the clearance angle is such that the sides of the tool for a 55-degree thread will make an included angle of 57 degrees.

In using the 55-degree Whitworth thread, I do this because the thread I have compiled data for is an 8-pitch Whitworth, though threads of any angle can be computed in the same manner as the one given.

Referring to the diagram, Fig. 3, which is figured for a thread of 1-inch pitch and an angle of 57 degrees, with Whitworth top and bottom, it will be seen that:

$$H = \frac{Cot\ 28° 30'}{2} = 0.920885$$

and as the depth of the Whitworth thread is equal to 4/6 of the hight of a triangle with a base of 1.00, then:

$$H_1 = H - \left(\frac{H}{6} \times 2\right) = 0.613925.$$

The distance a in the diagram is obtained as follows:

$$a = \frac{H}{6} \times \tan. \text{ 28 deg. 30 min.} =$$

0.083333 and

r = radius of top and bottom of thread $= a \times cot.$ 30 deg. 45 min. $= 0.14007$.

Then for a thread of 8 pitch, our figures will be:

$H = 0.920885$ $P = 0.115110$
$H_1 = 0.613925$ $P = 0.076740$
$a = 0.083333$ $P = 0.010416$
$r = 0.14007$ $P = 0.017508$.

It will thus be seen that the same procedure will be required, whether the tool is for Whitworth, V or U. S. thread and as the master tools are used only for finishing and preserved with especial care, their life is long and the cost of making is greatly offset by the results obtained in production, especially on work which is made up in large quantities in an engine lathe or a special machine designed on engine lathe lines.

Forthcoming Meetings

National Gas and Gasolene Engine Trades Association, Chicago, November 30, December 1 and 2. La Salle hotel. Albert Stritmatter, secretary, Cincinnati, O.

National Society for the Promotion of Industrial Education, annual convention, December 1, 2 and 3, Milwaukee, Wis. J. C. Monaghan, secretary, 20 West Forty-fourth street, New York City.

American Society of Mechanical Engineers, annual meeting, New York City, December 7-10. Calvin W. Rice, secretary, United Engineering building, New York City.

American Society of Agricultural Engineers, third annual meeting, December 28-29, 1909, Ames, Ohio. F. W. Chase, secretary, University of Nebraska, Lincoln, Neb.

Inquiry for Machinery

(190)—Machine for extracting fiber from cocoanut husks wanted by a client.

Business Items

The Screw Machine Products Company, of Providence, R. I., has moved into its new plant at the corner of Eddy street and Thurber's avenue, and has about an acre of floor space. Its facilities have been greatly enlarged, enabling it to take care of its increasing business.

Business Opportunities

J. H. Hanley, Eldora, Iowa, will build a garage in the spring.

Stratten & Co., Penacook, N. H., is building a new power house.

J. B. Duke, Raritan, N. J., is erecting a large pumping station.

The Waynesboro (Penn.) Gas Light Company will erect a new plant.

The South Dayton (N. Y.) Canning Company will install a new boiler.

The Orr Felt and Blanket Company, Piqua, Ohio, is erecting a new factory.

Hoyt Electrical Instrument Company, Penacook, N. H., is building a garage.

The Foster Bolt and Nut Company, Cleveland, Ohio, will build a new factory.

The Stonington (Conn.) Velvet Mill Company will erect a two-story addition.

The Aluminum Company of America is to extend its plant in Niagara Falls, N. Y.

The Milwaukee (Wis.) Machine Tool Company is considering the erection of a new plant.

Erickson & Son, Portchester, N. Y., will erect a plant for structural iron work.

The Wilson Optical Works, Reading, Penn., will erect a large addition to its plant.

The Cattaraugus Cutlery Company, Little Valley, N. Y., is building a new factory.

The Pillsbury Mill Compony, Minneapolis, Minn., will build a $250,000 steam power plant.

Kerrfield & Lamoreaux, Washburn, Wis., are erecting an addition to their box factory.

The Radel Leather Manufacturing Company, Newark, N. J., will erect a new building.

The Racine-Sattley Company, Racine, Wis., will engage in the manufacture of automobiles.

The Pfanstiehl Electrical Laboratory, North Chicago, Ill., is installing a new machine department.

The Eastern Tanners Glue Company, Gowanda, N. Y., is doubling the capacity of its plant.

The Superior Foundry Company, Cleveland, Ohio, will erect a new $50,000 foundry building.

The Utica & Willowvale Bleachery, Willowvale, N. Y., expect to buy a pipe-threading machine.

The Chicago (Ill.) Ornamental Iron Company has purchased site for an addition to its plant.

C. H. Masland & Son, Philadelphia, Penn., carpet manufacturers, will erect an addition to their plant.

An addition is being built to the metal-working plant of G. A. Richards, Grand Rapids, Mich.

The Baldwin Chain and Cycle Manufacturing Company, Worcester, Mass., is erecting a two-story addition.

The sawmill of the Falmouth (Ky.) Milling Company was destroyed by fire. Loss, about $10,000.

The Somerville (N. J.) Iron Works is erecting an addition to its plant and will also increase the power plant.

The Kansas Ice and Cold Storage Company, Wichita, Kan., a new concern, will erect a $40,000 plant.

It is reported the Covert Motor Vehicle Company, Lockport, N. Y., will erect an additional factory.

The Merchants Light and Power Company, Montreal, Canada, is having plans prepared for a new plant.

The plating works and machine shop, of Lawrence Brothers, Rock Falls, Ill., were damaged by fire.

The Bury Compressor Company, Erie, Penn., is planning to erect a new addition to plant to cast about $50,000.

The plant of the W. N. Stratzer Iron and Steel Company, Pittsburg, Penn., was burned. Loss, about $80,000.

England & Bryan, Philadelphia, Penn., hides and leather, will erect a new factory at 315-17 New street.

The International Silver Company has awarded contract for an addition to its plant at Wallingford, Conn.

The Standard Connecting Rod Company, Beaver Falls, Penn., has purchased site for a new machine shop.

It is reported the Buckeye Foundry Company, Cincinnati, O., may erect a new plant at Camp Washington.

Armour & Co. is to erect a woodworking plant in Hill City, Minn., for the manufacture of pails and tubs.

The Reading (Penn.) Railway is considering plans for the erection of a new shop for repairing its steel cars.

The Somerville (N. J.) Stone Company is contemplating the erection of a new plant to replace the one destroyed by fire.

The Worumbo Manufacturing Company, Lisbon Falls, Me., is building a machine shop and electric power plant.

The Superior Tap Company, Springfield, Vt., is to move to Charlestown, N. H., where a new plant will be erected.

The Pennsylvania Railroad will erect shops at Terre Haute, Ind., which will involve an expenditure of $2,000,000.

The J. & J. Cash Company, South Norwalk, Conn., manufacturers of textiles, is planning to extend its plant.

The Fillmore Foundry and Iron Works, Buffalo, N. Y., will make extensive improvements and additions to its plant.

The Holliday & Wyon Company, Indianapolis, Ind., manufacturing harness and harness goods, will erect a new factory.

Dwyer Bros. Beet Sugar Machinery Company, of Cleveland, O., is considering establishing a plant at Aberdeen, S. D.

The Sanitary Can Company, Fairport, N. Y., has purchased land on which, it is said, a large machine shop will be erected.

The Buffalo Auto Truck and Motor Company will build a plant at Mt. Morris, N. Y., for the manufacture of auto trucks.

The Smith & Watson Iron Works, Portland, Ore., will erect a plate and forge shop in connection with its present plant.

The Oswegatchie Light and Power Company, Gouverneur, N. Y., will erect a large electrical power plant at Hailesboro.

The Springfield (Ill.) Motor Car Company has incorporated and will erect a new plant at once. This will employ 100 men.

The Hallin Gas Engine and Boat Company, Tacoma, Wash., incorporated at $10,000, will erect a plant. A. Ohlson is president.

The sawmill of the North River Lumber Company, at Widdifield, near North Bay, Ont., was destroyed by fire. Loss, $10,000.

The Corcoran Lamp Company, Cincinnati, Ohio, will locate in Detroit, Mich. The company manufactures automobile lamps.

The Beaver Manufacturing Company, Buffalo, N. Y., manufacturing finished wall board, will erect a new $35,000 plant.

L. Koven & Bro., Jersey City, N. J., boilermakers and machinists, will erect an addition to their plant, also a new power house.

The Bird & Wells Lumber Company, Wausaukee, Wis., will enlarge its plant and install machinery for manufacturing woodenware.

Deere & Co., Moline, Ill., contemplates the erection of a foundry at East Moline, which, it is said, will be the largest in the world.

Fire destroyed the electric-light plant at Ordway, Colo. Plant was owned by Bornschein Brothers, who will rebuild the same.

The W. F. Norman Sheet Metal Manufacturing Company, Nevada, Mo., will start the erection of new buildings to replace its burned factory.

The Allegheny Steel Company, of Tarentum, Penn., is preparing to spend $1,000,000 on improvements to plants at Tarentum and Brackenridge.

The sawmill of the John R. Davis Lumber Company, at Phillips, Wis., destroyed by fire recently, will be rebuilt. Loss was about $150,000.

Plans have been completed for the new wire plant of the American Steel and Wire Company, near Ensley, Ala. This is to cost about $3,000,000.

The Pacific Garage Company, Granite and Pacific street, Vancouver, B. C., has opened a garage and will install a complete new machine shop.

H. C. Reese Company, Jersey City, N. J., lace-curtain refinishers, will erect an addition to its plant. Will also install new boilers and engines.

The Weller Manufacturing Company, Chicago, Ill., manufacturing elevating, conveying and power transmission machinery, will erect a new plant.

The McClintic-Marshall Construction Company, of Pittsburg, Penn., will erect a structural steel plant at Indiana Harbor, Ind., to cost $500,000.

The Buffalo-Pitts Company, Buffalo, N. Y., building threshing machinery, has bought site in St. Paul, Minn., on which a $100,000 factory will be erected.

The Russell & Erwin Manufacturing Company, New Britain, Conn., hardware manufacturer, is considering the erection of a new six-story factory building.

The Pratt & Whitney Company, Hartford, Conn., has awarded contract for the erection of two additional buildings, one to be used as small tool department.

F. W. H. Zimmer, Moscow, Russia, would like catalogs and quotations on apparatus for breweries, soap-works equipment, goods for railways, tramways and factories.

The New Jersey Dry Dock and Transportation Company, Elizabeth, N. J., is building an addition which will include machine shop, blacksmith shop, plate and angle mill.

The Kansas City (Mo.) Steel Scraper Company will establish a plant for the manufacture of steel scrapers, steel and wood wheelbarrows, etc. Address is Heist building.

The Merchants Despatch Transportation Company, East Rochester, N. Y., will enlarge its plant and manufacture steel underframes for its iron cars and others it may build.

The Western Maryland Railroad will make several additions to shops at Hagerstown, Md., including machine shop and blacksmith shop. H. R. Pratt, Baltimore, is chief engineer.

The Tuttle & Bailey Manufacturing Company, Buffalo, N. Y., recently incorporated, is preparing to erect a plant at Bridgeburg, Ont., for the manufacture of heating and ventilating apparatus.

H. L. Barton, formerly with Westinghouse Electric and Manufacturing Company, of Pittsburg, has organized the Metal Products Company, Detroit, Mich., for the manufacture of automobile parts.

The Wm. O. Lee Company, Port Huron, Mich., has let contract for two new buildings, which will include foundry, furnace and coal room, also metal room. The company manufactures brass castings, etc.

It is reported the Maxwell-Briscoe Company is to erect a plant in Detroit, Mich., for the manufacture of automobiles. This will be plant No. 5, the company having plants in Tarrytown, N. Y., Newcastle, Ind., and two in Rhode Island.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: Nov. 23—Magnesia pipe covering (schedule 1919), rolled bronze, rolled zinc boiler plates (schedule 1917), machinery steel, tool steel Class C (schedule 1911), brass and iron machine screws, iron rivets, bolts, emery wheels (schedule 1915), pipe fittings, copper tubing, brass unions, check and globe valves (schedule 1918); Dec. 7—Steel bolts and nuts (schedule 1921), gage glass fittings, copper tubing (schedule 1923), brass tubing (schedule 1922).

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: November 30—Automatic gear cutter, boring and drilling machine, plate bending machine (schedule 1930), flat turret lathe (schedule 1929), slotting machine (schedule 1932), bolts and nuts (schedule 1950), drill sets, brass wood screws (schedule 1946); December 7—Saw bench, tripping table, power mortising machine, sand-papering machine, universal trimmer (schedule 1963), vertical turret boring and turning machine (schedule 1965), horizontal boring, drilling and milling machine (schedule 1962), motor-driven planing machine (schedule 1962), 36-inch motor-driven automatic bevel gear planer (schedule 1964); December 14—Duplex and differential blocks, I-beam trolleys (schedule 1958), tube cleaners (schedule 1960), twist drills, hydraulic jacks, vises (schedule 1958); December 21—Surface grinder (schedule 1954).

New Incorporations

Rockford Superior Furniture Company, Rockford, Ill. Capital, $100,000. Incorporators, A. W. Mann, P. O. Ugarph, Robert Larson.

Delaware Garage Company, Wilmington, Del. Manufacture, repair and store automobiles. Capital, $100,000.

Hanley Motor Car Company, Kittery, Me. Motors, engines, etc. Capital, $125,000. Incorporators, A. H. Peavey, G. E. Burnham.

National Equipment Company, Boston, Mass. Manufacture machinery, tools, etc. Capital, $2,000,000. W. M. Lowney, Mansfield, president.

Calumet Brass Foundry, Chicago, Ill., manufacture castings, fittings, etc. Capital, $10,000. Incorporators, Chas. T. Mason, John Tully, C. W. Lockard.

Star Motor Car Company, Indianapolis, Ind. Manufacture automobiles. Capital, $100,000. Incorporators, G. G. Shaw, J. W. Berauer, S. J. Summer, etc.

Forsberg-Carlson Manufacturing Company, Chicago, Ill. Manufacture machinery. Capital, $50,000. Incorporators, C. A. Forsberg, O. B. Carlson, F. B. Roos.

Kittel-Wessel Company, Jersey City, N. J. Manufacture buttons, hat pins, jewelry, etc. Capital, $25,000. Incorporators, P. B. Kittel, F. Woehl, J. Wendt.

Standard Automobile Company, Wheeling, W. Va. Manufacture automobiles. Capital, $25,000. Incorporators, E. J. Becker, G. W. Row, C. E. Morris, etc.

Central Machine Works, Camden, N. J. Manufacture machinery, automobiles, etc. Capital, $100,000. Incorporators, F. Apgar, C. Beney, J. C. Dunn.

Monarch Automatic Machine Company, Brooklyn, N. Y. Manufacture machinery, etc. Capital, $150,000. Incorporators, W. J. Collins, D. H. Crown, W. Brady.

Automatic Wrench Company, Chicago, Ill. Manufacture automatic wrenches, tools, etc. Capital, $50,000. Incorporators, W. D. LaParle, J. R. Kahn, Elias Mayer.

Non-Rust Metal Company, Wilmington, Del., Manufacture metal or wood specialties. Capital, $200,000. Incorporators, T. Jasper, F. Robinson, J. Elze, Beaver Falls.

Frank A. Maron Company, New York. Manufasture cases, boxes, cabinets, mouldings, etc. Capital ,$100,000. Incorporators, F. A. Maron, F. L. Sheip, J. P. Broomell.

The Thomson Filter Company, New York. Manufacture water filters, etc. Capital, $100,000. Incorporators, F. H. Waggoner, F. F. Craft, R. G. Davey.

Automobile Repair and Construction Company, New York. Machine shop, repair vehicles, etc. Capital, $300,000. Incorporators, M. Rosett, F. L. C. Keating, J. Palmer.

The Duplex Vacuum Engine Company, Chicago, Ill. Manufacture mechanical devices. Capital, $30,000. Incorporators, L. Kessler, J. Reckinger, A. L. Luessenhop.

Winters Automobile Company, Dover, Del., Manufacture automobiles. Capital, $25,000. Incorporators, R. Winters, Dunmore, Penn; A. Adair, J. R. Wilson, Scranton, Penn.

American Electric Machine and Elevator Company, St. Louis, Mo. Manufacture elevators, etc. Capital, $10,000. Incorporators, John T. Burke, Wm. A. Krauss, etc.

Motor Parts Company, West Orange, N. J. Manufacture motors, engines, machines, etc. Capital, $125,000. Incorporators, Wm. D. Sargent, Geo. M. Judd, Ed. H. Fellows.

Seaboard Structural Works, Jersey City, N. J., Construct bridges, trestles, etc. Capital, $400,000. Incorporators, E. C. Smith, Englewood; C. Schlegel, S. C. Lewis, Jersey City.

United Boiler Heating and Foundry Company, Hammond, Ind. Manufacture heating and power apparatus. Capital, $20,000. Incorporators, Otto Knoezer, C. H. Cass, Walter Williams, etc.

Greyhound Motor Works, Buffalo, N. Y. Manufacture vehicles, motors, engines, aëroplanes, etc. Capital, $100,000. Incorporators, F. C. Fox, W. C. Overman, J. W. Van Allen.

Empire Automobile League, New York. Manufacture cars, carriages, wagons, boats, machines, etc. Capital, $50,000. Incorporators, J. T. Manchester, J. Rosenberg, S. J. Hess.

Emerson-Brantingham Implement Company, Rockford, Ill. Manufacture implements and machinery. Capital, $50,000. Incorporators, R. Emerson, C. S. Brantingham, E. P. Lathrop.

Spaulding Manufacturing Company, Portland, Me. Furniture and wooden articles. Capital, $200,000. C. H. Gilmore, Melrose, Mass., president; D. A. Meakee, Portland, treasurer.

O. K. Clutch and Machinery Company, Camden, N. J. Manufacturing clutches, tools, implements and machinery. Capital, $50,000. Incorporators, A. Ruppel, H. Druschel, J. A. MacPeak.

Garbutt Machine and Foundry Company, Ogdensburg, N. Y. Mechanical and electrical engineers and machinists. Capital, $10,000. Incorporators, M. A. Jameson, M. E. Gray, W. D. Ingram.

The Only Car Company, Echo, N. Y. Manufacture automobiles, engines, aëroplanes, etc. Capital, $300,000. Incorporators, R. E. Lober, Port Jefferson, N. Y. J. D. Castlow, Roy Fishel, New York.

The Ironwork Company, Jersey City, N. J. Manufacture iron work and machinery. Capital, $125,000. Incorporators, Boyd MacLean, J. H. Palmer, Chas. Young, 1 Montgomery street, Jersey City.

Underwood Computing Machine Company, New York. Manufacture computing machines, etc. Capital, $700,000. Incorporators, H. G. Teele, Brooklyn. F. E. Anderson, Freehold, N. J. W. Wright, New York.

Acme Gas and Electric Fixture Company, New York. Manufacture gas and electric fixtures, gas chandeliers, etc. Capital, $30,000. Incorporators, S. Wallach, S. H. Shiminsky, New York; H. L. Adelman, Brooklyn.

Elmore Motor Car Company, New York. Manufacture motors, engines, machines, etc. Capital, $20,000. Incorporators, Geo. W. Post, Jr., Bronxville; C. J. Post, Jr., 151 West Fifty-seventh street, New York, etc.

Jarvis Chuck Manufacturing Company, 112 Broad street, Lynn, Mass. Manufacture drawin chucks, small automatic and special machinery, press tools for sheet metal work. E. J. Laffan, president; J. A. Jarvis, secretary and general manager.

The Balston Manufacturing Company, New York. Manufacture typewriting and word- and phrase-writing machines. Capital, $2,000,000. Incorporators, Robert L. Johnstone, S. A. Nicholas, New York, O. F. Balston, Brooklyn, N. Y.

Interchangeable Gear Company, Newark, N. J. Manufacture interchangeable and other gears. Capital, $125,000. Incorporators, B. Franklin Sparr, 9 Warren street, Newark; A. C. Kellogg, 619 East Seventeenth street, Brooklyn, N. Y., etc.

New Catalogs

Gardner Machine Company, Beloit, Wis. Circular showing grinding operations on gas-engine parts.

E. C. Bliss Manufacturing Company, Providence, R. I. Circular illustrating and describing milling attachment.

Bickford & Washburn, Greenfield, Mass. Folder illustrating and describing thread-milling machine for pipe taps.

Hermance Machine Company, Williamsport, Penn. Catalog of woodworking machinery. Illustrated, 64 pages, 6x9 inches, paper.

S. W. Card Manufacturing Company, Mansfield, Mass. Catalog of Paragon screw plates. Illustrated, 10 pages, 4x7 inches, paper.

W. S. Rockwell Company, 50 Church street, New York. Folder illustrating and describing annealing and hardening furnaces, oil or gas fuel.

Pawtucket Tool Company, Inc., Pawtucket, R. I. Catalog of Thompson automatic tapping chucks. Illustrated, 3½x6 inches.

The Electric Controller and Manufacturing Company, Cleveland, Ohio. Catalog of lifting magnets. Illustrated, 62 pages, 6x9 inches, paper.

F. A. Errington, 39 Cortlandt street, New York. Catalog and circulars of opening dies, tapping chuck, friction screw driver, stud or nut setter, etc.

The Owen Machine Tool Company, Springfield, Ohio. Catalog C describing universal, plain and duplex milling machines. Illustrated, 62 pages, 6x9 inches, paper.

H. W. Caldwell & Son Co., Chicago, Ill. Catalog No. 34, describing elevating, conveying and power transmitting machinery. Illustrated, 848 pages, 6x9 inches, cloth.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Folder illustrating and describing pressure controlled speed regulator for boiler feed pumps, gas-pressure systems, etc.

B. F. Sturtevant Company, Hyde Park, Mass. Catalog No. 165 describing fans, blowers, dust collectors, fuel economizers, engines, motors, turbines, etc. Illustrated, 56 pages, 4x9 inches, paper.

The Waterbury Farrel Foundry and Machine Company, Waterbury, Conn. General catalog of rivet, bolt and nut machinery, cartridge machinery, drop presses, drop hammers, hydraulic machinery, lathes, etc. Illustrated, 206 pages, 6x9 inches, cloth.

Diamond Machine Company, Providence, R. I. Catalog D describing grinding and polishing machinery, including heavy face grinders, lathe grinding attachments and center grinders, disk and emery ring grinders. Illustrated, 216 pages, 6x9 inches, paper.

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper catalog free. E.G. Smith, Columbia, Pa.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Machines designed; automatic special. Practical working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emery & Co., Newark, N. J.

Have you small, complicated experimental work or tool designing others can't do? Send to Benj. O. Butler, Taunton, Mass.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

Arthur C. Mason, designing engineer; practical working drawings; special machinery developed. 227 Canal St., New York City.

Metal specialties manufactured, models, dies and special machinery; inventions perfected. Villinger Mfg. Co., Williamsport, Pa.

Special machinery developed; practical working drawings prepared by experienced designers. The Engineering Service Co., 413 Fort Dearborn Building, Chicago, Ill.

Machinery to manufacture on contract; designers, patternmakers and founders; we can handle work from very light up to 15 tons. Hydrostatic Machinery Co., Rochester, N. Y.

Wanted—Purchaser for No. 2 Farwell milling machine. Grant hobbing machine and Gisholt tool grinder; all practically new and in A-1 condition. Box 755, AMER. MACHINIST.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Castings, pattern and machine work; having capacity in our foundry, pattern and machine shops, above our present requirements, we would like to take on a few good contracts for building machines requiring both foundry and machine work. Wm. E. Hill & Co., Kalamazoo, Mich.

Your patent attorney should be a mechanical expert, because the Patent Office examiners are; no other attorney is a member of both the A. S. M. E. and A. I. E. E.; mail invention for moderate estimate and free opinion and advice. Edward P. Thompson, M. E., McGill Building, Washington, D. C.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Position as superintendent or general foreman, now engaged; practical and executive experience; good reliable mechanic, thorough experience in modern shop methods of rapid production. Box 925, AMERICAN MACHINIST.

INDIANA

Wanted—Position as shop manager or special machine tool salesman; for past ten years have manufactured and sold turret lathes, boring mills and special tools and fixtures for reducing cost; I wish to change from present position about January 1 next. A. S. M. E., No. 2967, Box 903, AMER. MACH.

MASSACHUSETTS

Foreman toolmaker, at present employed, desires change. Box 872, AMER. MACHINIST.

Technical graduate, experienced on general machinery and automobile design, wants a change. Box 919, AMERICAN MACHINIST.

NEW JERSEY

Wanted—Position as machinery salesman or inspector by young man (32), with shop and technical experience; moderate salary to start. Box 911, AMERICAN MACHINIST.

Position by mechanical engineer, nine years as superintendent, five years as general foreman machine shop; technical education; at present well connected. Box 912, AM. MACH.

Salesman—Machine tool salesman as sales manager, having 15 years' experience, both in the manufacture and selling of machine tools; competent judge of condition and value of second-hand, and familiar with all makes in the United States; can give best of reference. Box 790, AMERICAN MACHINIST.

NEW YORK

Designer; automatic and special machines; experienced; near New York City. Box 915, AMERICAN MACHINIST.

Expert heat-treating and carbonization man desires change; wide experience and executive ability; automobile work preferred. Box 920, AMERICAN MACHINIST.

Superintendent desires position; large experience in machine shop and foundry equipment, organization and production. Address Box 928, AMERICAN MACHINIST.

Mechanical engineer, European graduate, two years' experience in drafting room and shop, desires position with a good house where is chance of advancement. Box 927, AM. MACH.

Specialist on crude oil engines desires position of full responsibility in which reliable designs and modern production engineering can help earning dividends. Box 926, AM. MA.

Mechanical engineer and designer, seven years' practical experience in drafting room and shop; wants position offering a future; good references. "H. L.," Box 895, AM. MA.

Superintendent or general foreman familiar with modern shop practice and equipment and the manufacture of interchangeable work; pattern, foundry, die, tool and drop forging and drafting room experience; American, 37. Box 932, AMERICAN MACHINIST.

Automobile engineer desires position, vicinity New York; expert at designing, improvement, laboratory work and engine testing; also construction, repairing and running; nine years' experience in French and American factories; highest references. Address "E. V. H.," AMERICAN MACHINIST.

Electrical engineer with highest references, wishes to form connection with good concern, preferably in or near New York; three years' experience in Mexico, five years in Chile; speaks Spanish and German fluently; has had wide experience, both in selling and constructing electrical, steam and hydraulic machinery; open for immediate engagement. Address "H. K. W.," AMERICAN MACHINIST.

OHIO

Mechanical engineer, experienced machine tool designer, wants change; charge of designing department or assistant superintendent preferred; college graduate; age 33; married; A-1 references. Box 906, AMER. MACHINIST.

Works manager or general superintendent invites correspondence from reliable concerns wishing to secure the services of a high-class executive with a clean-cut record as an earning power. Address Box 924, AMER. MACH.

PENNSYLVANIA

Foreman, toolroom or general shop foreman, up-to-date in modern shop methods; at present employed; good reference; age 31. Box 914, AMERICAN MACHINIST.

Chief draftsman in charge of office employing two to five men, desires change offering advancement; would consider position as designer or assistant superintendent. Box 921, AMERICAN MACHINIST.

WISCONSIN

Competent, progressive, up-to-date executive, at present filling position as assistant to general superintendent, desires change. Box 930, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted—Experienced mechanical draftsmen for detail work, in a concern manufacturing general rolling mill and hydraulic machinery; state age, experience and salary expected. Box 796, AMERICAN MACHINIST.

Wanted—In every machine trade center, a live man, with trade acquaintance, to sell a high-class and money-saving tool, already widely used and advertised; give age, experience and references. Box 888, AMER. MACH.

Salesman wanted, having had experience in selling to the mill supply and hardware trade, also manufacturers to represent us in our chain block department; give experience and references. Box 866, AMERICAN MACHINIST.

DELAWARE

Wanted—A man who is thoroughly familiar with case hardening and blueing; we have a good position for the right man in one of the finest firearms factories in the country. In reply, give age, experience and salary expected. Box 899, AMERICAN MACHINIST.

ILLINOIS

Wanted—A working foreman to take charge of cutter department; we have a permanent position for one who is thoroughly conversant with the manufacture of milling cutters. Box 892, AMERICAN MACHINIST.

Wanted—Diemaker for pressed steel work; must be thoroughly acquainted with construction of dies for drawing, piercing and forming; give experience, state wages; steady employment for right man. Box 893, AM. MA.

Wanted—Diemakers; high-grade men for small accurate work; toolmakers for gage, jig and fixture work; milling-machine operators for tool-room work; automatic screw-machine operators for Brown & Sharpe and other automatic screw machines; on this line of work we pay competent men 39 cents per hour; added premiums will make this rate average 42 cents per hour; hand screw-machine operators. In answer give full information. Address Department 1056, Western Electric Company, Chicago.

MASSACHUSETTS

Wanted—First-class draftsmen. Apply Supervisor of Drafting Room, General Electric Co., Pittsfield, Mass.

Wanted—Several union diemakers accustomed to accurate work; union shop; 54 hours a week, first-class wages to first-class workmen. Triumph Voting Machine Co., Pittsfield, Mass.

Wanted—A practical mechanic to take charge of tool and repair department in machine shop; one with executive ability and practical tool experience on gear cutters preferred. Boston Gear Works, Norfolk Downs, Mass.

Wanted—A practical pump man; one who can design, estimate power, efficiency and cost and superintend construction; would prefer a man who has had experience in steam engine and electrical work in connection therewith. Address, giving age, experience and references. "Pump," AMERICAN MACHINIST.

Wanted—General manager's assistant in an established trade, from 30 to 40 years old; up-to-date general mechanical and business ability on estimating, cost accounting, etc.; one with shop experience preferred; executive ability, quick and energetic. Applications in writing only, stating terms, and with references. Boston Gear Works, Norfolk Downs, Mass.

Wanted—Electrical draftsmen and mechanical draftsmen; pay from $3.60 to $5.04 per diem; a competitive examination will be held at the Navy Yard, Boston, Mass., November 30, 1909, for the purpose of establishing an eligible register of electrical draftsmen and mechanical draftsmen. For application and further information address, "Commandant, Navy Yard, Boston, Mass.'

Wanted—Demonstrator; a large manufacturing company desires to communicate with a party or parties who have had practical machine shop experience to demonstrate to factories; must be able to give first-class references, steady and industrious; this company desires preferably parties to be not over 40 years of age; steady work guaranteed; state salary desired. Box 916, AMER. MACHINIST.

MICHIGAN

Wanted—First-class man experienced in tracing stock. Address Hudson Motor Car Company, Detroit, Mich.

Wanted at once, toolmakers, die sinkers, trimming diemakers, machinists, automatic screw machine hands; state age, experience, customary wages and references. Buick Motor Company, Flint, Mich.

Draftsman Wanted—One A-1 layout man, familiar with current practice in automobile design; a thoroughly reliable and accurate man is required and one who can turn out work in reasonable time; to such a man a good salary will be paid and opportunity offered for advancement; we have openings also for a careful checker and two detailers and two experienced tool and jig designers; only first-class men with mechanical experience wanted. Reliance Motor Truck Co., Owosso, Mich.

MISSOURI

Wanted—Experienced machine tool salesman for Missouri, Kansas and Texas. W. R. Colcord Machinery Co., St. Louis, Mo.

Wanted—Traveling salesman for St. Louis territory; experienced in selling machinists' supplies. W. R. Colcord Machinery Co., St. Louis, Mo.

Wanted—A-1 operator for Potter & Johnston semi-automatic machine; one who can make his own repairs; answer, giving experience and wages expected to Wagner Electric Mfg. Co., St. Louis, Mo.

NEW JERSEY

Wanted—Four experienced draftsmen on gas engines; state experience, reference and salary expected. Box B, AMER. MACHINIST.

Wanted — First-class machinists, lathe, planer, boring and milling machine operators; good wages and steady work for right parties. Trenton Engine Company, Trenton, N. J.

NEW YORK

Good header men wanted for night work; good pay, steady job. Box 918, AM. MACH.

Wanted—Superintendent for general machine shop and foundry; salary $2000; state age, experience and former employment. Box No. 4A3, AMERICAN MACHINIST.

Wanted—Machine shop foreman for shop employing about fifty men; jobbing shop on heavy work; state experience, age and salary wanted. Box 887, AMERICAN MACHINIST.

Wanted—Western sales representative for well established eastern company manufacturing steam boilers, water pipe in all sizes; also engineering work. Box No. 3A5, AMER. MACH.

Wanted—Planer hands, lathe hands and all-round machinists; steady job; no strike; state experience and wages wanted. Address W. B. Peirce, 169 Vandervoort St., North Tonawanda, N. Y.

Wanted—A mechanical draftsman about 30 years old, married; familiar with mill work; steady job for right man; town of 6000 in New York State, having first-class schools. Box 886, AMERICAN MACHINIST.

OHIO

Wanted—First-class machinists; no labor troubles. The Heisler Co., St. Marys, O.

Wanted—One Gisholt, one boring mill, one lathe man; increasing force. Box 929, AM. M.

A gas-engine salesman; mechanical engineer to take charge of office. Box 896, AM. MACH.

Machinists wanted on machine tools and erecting floor; no labor troubles. Lima Locomotive and Machine Co., Lima, Ohio.

Wanted—Experienced draftsman for designing and detailing on sheet-metal working machinery; steady position offered. Box 870, AMERICAN MACHINIST.

Wanted—Clerk for drafting room capable of making and keeping up bill of material and records of blueprints. Write, stating experience and salary to Box 878, AMER. MACH.

Wanted—First-class large lathe and planer operators; good wages and steady work for the right parties; location, medium size town in central part of Ohio. Box 834, AM. MACH.

Machinists—We are increasing our output and invite application from machinists with experience on planers, turret lathes, boring mills, milling machines, screw machines, etc.; state fully, experience and wages. Foos Gas Engine Co., Springfield, Ohio.

Applications wanted from erectors on pumps, compressors, etc.; also from planer hands; boring mills and big radial operators for heavy work; state wages expected, past experience and names of past employers. Z. Y. X., AMERICAN MACHINIST.

Wanted—Draftsman capable of overseeing detail work of about four men on small work; must be able to get quantity of work out and have it right from shopman's standpoint. Apply, giving full particulars of past experience and salary expected to Box 879, AM. M.

Production expert for large shop manufacturing compressors and other heavy and medium machinery; must be competent to devise economical method of machining and understand cutting tools thoroughly; applications considered only from those having experience and record in such work. A. B. C., AM. MA.

Wanted — First-class machinists, lathe, planer, brass molders, drill press, screw machine, boring and milling machine operators, die sinkers and patternmakers who are seeking positions or desirous of improving on those which they have, to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address Commissioner's Office, 605 New England Building, Cleveland, O.

PENNSYLVANIA

Help Wanted—Designer and draftsmen on general machinery; first-class designer, capable of taking charge of work; also one draftsman wanted. Box 890, AMER. MACH.

Wanted—A first-class machine tool operator, one who is familiar with working in repair shop and qualified to take foremanship. In reply, state age, reference and wages expected. Box 913, AMERICAN MACHINIST.

Wanted—Large engine shop wants progressive head foreman to increase production; excellent opportunity; position steady; must be an aggressive hustler with experience; give references. Address Box 910, AMER. MACH.

Superintendent—Qualified to take entire charge of plant manufacturing brass and iron valves, fittings and steam specialties from foundry to finished article; also familiar with high-pressure piping installations; give references and full details regarding mechanical and executive experience; good position for high-grade man; communications strictly confidential. Box 917, AMERICAN MACHINIST.

WISCONSIN

Draftsman Wanted—About thirty years old, having had experience on paper machines; none others need apply; send references, very full particulars as to experience and lowest salary required. Box 853, AMER. MACHINIST.

For Sale

For Sale—One small dynamo for electro plating work. Speakman Supply and Pipe Co., Riverview Works, Wilmington, Del.

For Sale—One factory or storage building 215'x64' heavy frame construction two stories high with ell 130'x30'; cost $16,000; also one steel stack, 100' high and 4' diameter; building two years old; located on railroad siding; will sell cheap. Send for blueprints and photographs. Box 922, AMERICAN MACHINIST.

For Sale—Large, powerful screw machine with gap bed, wire feed, geared friction head, geared face plate, power feed to turret, double tool post cross slide and triple friction countershaft; capacity of wire feed, 1 15/16; weight, 4100 pounds; in very good condition; can be bought at low price. Box 923, AM. M.

For Sale—Patent No. 916,512; self-timing speed indicator; a most improved instrument; center runs idle till clutch is thrown in; when revolutions for the desired time are registered it will disconnect automatically, thus no watch is needed, nor light; one hand can operate it, which is convenient for shafts near floor or ceiling; simple in construction and cheap to manufacture. K. Weiss, 30 Woodlawn Terrace, Waterbury, Conn.

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